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Opposition to the Trolley System.

IT would be interesting to know the exact reason for the virulent opposition displayed by some of the daily papers to the introduction of the trolley system. It might be charitable to suppose that it has arisen from dense ignorance, but that hypothesis is barred out for two reasons. In the first place the average newspaper man of the better class keeps himself tolerably well informed about modern improvements; and, in the second place, the reporters who have interviewed certain electricians on the subject of the overhead system, have done so not with the object of getting unbiased information, but for the purpose of obtaining ex parte statements against the trolley. This is disingenuous, as it both displays a spirit highly undesirable in journals that purport to be fair minded, and further it lays open the authors of these attacks to the accusation of pecuniary rather than professional partiality. There are undoubtedly legitimate objections to the trolley system, most of them æsthetic rather than practical, but it is hardly in accord with the spirit of modern progress for influential and presumably honest journals to devote themselves to vicious onslaughts upon modern improvements, without taking the trouble to investigate both sides of the question. The trolley system where it has been fairly tried has neither failed, nor made itself objectionable except to a comparatively small portion of the community. It has come to stay, at least until something better shall be devised; and the best answer to its detractors is to point to nearly 300 roads in operation, and to the equipment companies, weeks behind their orders in the work of constructing scores of additional lines.

An Electrical Fairy Tale.

ONE of the most amusing electrical fantasies that it has been our luck to see in many a month is the remarkable yarn entitled "The Water Devil," spun by that prince of grotesque story tellers, Frank R. Stockton. The motif of the story is the sudden stopping of a steamer without apparent cause or visible obstruction, and the curious happenings that follow this extraordinary occurrence. After various terrible hypotheses that the steamer is in the grip of some marine monster, it eventually turns out that a cargo of storage batteries, presumably formed and sent in a charged condition, have been leaking electricity and converted the craft into a gigantic magnet that picks up and fastens itself to the iron sheath of a broken cable. Thus moored, there is no escape until either the electricity gives out or assistance comes. The latter is the alternative chosen by the versatile author, for it gives an opportunity for explaining what otherwise would have been hopeless. It is but a whimsical tale, but it shows how even a thing so apparently prosaic as the storage battery, and destructive of imagination as modern industry, can be turned and twisted into furnishing forms that have at least the merit of striking originality.

Professor Crookes' Lecture.

THE presidential address of Professor Crookes before the Institution of Electrical Engineers is a paper replete with suggestiveness for those who would follow the phenomena of electricity into a realm that at present lies without the practical applications of science, but that to-morrow may be in a chosen field for investigations of far-reaching importance. No man is better fitted than Professor Crookes to speak of the electrical phenomena that take place in so-called vacua; and no one has penetrated more deeply into the mysteries that surround the electrical behavior of the ultimate particles of matter. The remarkable and often very beautiful phenomena observed when we pass an electric current through a vessel partially exhausted of its gaseous contents remained for many years mere curiosities of the laboratory until Professor Crookes and a small group of other investigators sought in them a means of investigating the marvelous properties of matter in its most rarefied form. To-day, realizing as we do the intimate connection of light and electricity, new interest is lent to these experiments on vacua. Some day they may reward the investigator by the discovery of methods of producing luminescence now quite unknown to us. The study of Professor Crookes' address not only gives a capital idea of the exquisite beauty of the phenomena, and the wonderful insight they give us into the structure of gases, but are full of suggestiveness to the student who would find in the behavior of electricity under extraordinary circumstances evidence as to the nature of the forces that we call electrical. We give in the present issue but a portion of this valuable paper: the rest of it will soon follow, and we feel sure that our readers will find in it a great deal that is of more than transient interest and worthy of most thoughtful attention.

Modern Theories of Electricity.

AN interesting discussion is just going on in England between Heavyside, Lodge and other champions of modern theory and certain hard-headed electricians of the old school who do not approve of these new-fangled notions. Open debates in the journals do capital service in bringing out both the strength and weakness of theories, and nothing is more likely to enable us to estimate them at their real value than discussion, even if it be led by the most obstinate of old fogies. Science seldom moves steadily forward, clearing its way as it goes; it is far more likely to dart ahead, leap around an obstacle, and establish itself by working in both directions at once. Theories are very apt to lead some of their followers to overstep the bounds that are ultimately determined; so it is in modern electricity. Much of the advance in theory has been conservative, straightforward, steady; some of it brilliant, inspiring, somewhat erratic; in the latter category we are inclined to place some of the views which have been put forward by followers and disciples of Dr. Lodge. His mechanism of the ether and of material electricity is exceedingly beautiful and ingenious as an illustration of the relations between electrical phenomena, but we very much doubt whether Dr. Lodge himself would be willing to endorse all the extremely materialistic views that have been imputed to him by followers who do not couple his originality in hypothesis with the mathematical training that can keep it in check. The time is not yet ripe for the complete discussion of these advanced electrical theories. Since the phenomena mathematically considered, involve, for the most part, merely the flow of a certain directed quantity, we need a vast amount of carefully aimed and exhaustive experimentation to make us reasonably certain of any given physical interpretation of the equations.

The Telephone Patents.

IN December the fundamental patent on the speaking telephone granted in England to Alexander Graham Bell expired, and our British cousins are congratulating themselves on relief from a monopoly that has made itself somewhat obnoxious to them. Competition has already sprung up and telephone rates have been reduced. In view of these facts it may be worth while briefly to review the principal patents that have enabled the Bell Telephone Company to hold its own against any and every attempt at competition, and to note in what state their successive expirations will leave the art of telephony. The fundamental patent was granted on the 7th of March, 1876, just 21 days after the filing of the application. Its principal feature is the enormously sweeping fifth claim for transmitting vocal sounds by electrical undulations that has successfully held its own against every inventor. As is now well known, the patent was entitled "An Improvement in Telegraphy," and the other claims are comparatively unimportant, as the transmission of speech is not mentioned in them. The armature of the rudimentary form of telephone, shown in the drawings, is supported at a single point and actuated mechanically by a flexible diaphragm. This patent will expire on March 7, 1893, its life being quite unaffected by the expiration of the English patent, since the latter was taken out after the American one was granted. It will be seen, therefore, that on the expiration of this patent the broad principle is thrown open and operative receiving and transmitting instruments can be freely manufactured. But it should be remembered that Alexander Graham Bell took out a second patent on the 30th of January, 1877, covering the important features of the form of receiver generally used in every part of the world. His claims cover the diaphragm of magnetic material, and means of adjusting it to its proper relation with the magnet. This second patent will probably enable the ordinary forms of construction to be held from public use until Jan. 30, 1894, after which day the receiver substantially as now known will become public property. As to the transmitter the case is somewhat more complicated. The principal patents on the carbon transmitter were granted to Thomas A. Edison on April 30, 1878, are now controlled by the Bell Telephone Company, and will expire April 30, 1895. The Edison transmitter is successful, but has not been in very general use. The form of transmitting instrument most widely employed, especially for long-distance work, is that patented by Hunnings. It is an English invention, and the American patent granted Aug. 30, 1881, will expire with the previous English patent on Sept. 16, 1892; it is, however, antedated by the Edison patent, so that the Bell Telephone Company will hold a claim on the carbon transmitter until the expiration of the latter. The Blake form of transmitter is the subject of a group of patents dated Nov. 29, 1881, but is the result of the division of an application filed Jan. 3, 1879, and the entire group patented in England in that year will pass out of legal existence on Jan. 20, 1893. There is, however, a patent to Berliner, also owned by the Bell Telephone Company, covering the same principle which is used in the Blake transmitter, that of varying contact between two electrodes; this will expire on Jan. 15, 1895, and includes the induction coil apparatus now usually employed. It will thus be seen that while the receiver becomes public property, at least in some of its forms, in 1893, the group of transmitter patents are likely to tie up that part of the telephonic system for nearly two years thereafter. Of course the Bell receiver can be made to work quite successfully as a transmitter, and it is altogether probable that modifications of it will be found to operate far more successfully than is generally supposed In any contingency a thoroughly successful telephone for anything except long-distance lines can be manufactured by any one who chooses, after the expiration of the second Bell patent Jan. 30, 1894. A single additional contingency with respect to the carbon transmitter may be mentioned. This instrument has been claimed by the now notorious Daniel Drawbaugh, his chief opponent in the patent office being Edison. The Drawbaugh application was filed considerably later than Edison's, but possibly might be ruled to come within the statutory limitations if there were no serious opposition. It is within the bounds of possibility then that an effort might be made to tie up the transmitter for another long term of years by establishing a legal priority for Drawbaugh in default of an active opposition in behalf of Edison. Such a combination of circumstances might come about if the Bell Telephone Company were interested in allowing the issue of a patent to the alleged Pennsylvania inventor. This statement of the condition of the telephone patents is necessarily incomplete, since we have made no attempt to discuss all the accessory apparatus that is in use to-day; but it will have served its purpose if it calls public attention to two things: first, the expiration of the fundamental telephone patent, and the way in which this blessing is mitigated by the transmitter patents; and, second, to possible legal machinations for securing a continued monopoly on the carbon transmitter.

Latest Electrical Foreign News.

(By Cable from Our Regular Correspondent.)

London, Feb. 2.—The central station at Deptford, which has already been so long in the process of reconstruction, will probably not commence operations until the middle of the present month. Mr. Ferranti proposes to arrange an earthing system at Deptford, but the requisite permissions from the post office and the board of trade have not yet been obtained. Owing to the very serious earth disturbances that might be produced it is somewhat doubtful whether the system will be permitted.

The City & South London Railway is running smoothly, as usual; occasional hitches occur, but the daily average of passengers is maintained up to 15,000. The residents of Peckham and Dulwich have memorialized the City & South London Railway Company for the extension of the line for the accommodation of these districts.

The St. James and Pall Mall Company have accepted a license from the Lane-Fox Company under the famous distribution patent of 1878.

The Elmore Works at Leeds have just been visited by representatives of the press.

The first electric light cable in the city will be laid, with the formal assistance of the Lord Mayor, to-morrow, Feb. 3.

At the meeting of the Institution of Civil Engineers on the same day Mr. Llewelyn Atkinson will read a discussion of electric mining machinery.

NEW BOOKS.

Electric Bell Construction. F. C. Allsop. Pp., 131. Ills., 177. London : E. & F. N. Spon, 1890. $1.25.

This little book is intended to be supplementary to the same author's well-known little work on "Practical Electric Bell Fitting." Its object is to give a complete and detailed description of the chief apparatus used in electric bell work, with explicit directions for manufacturing. A very large number of standard apparatus are explained in detail. and complete enough working instructions are given to enable the manufacture to be undertaken intelligently. The drawings are to scale, each figure being either full or half size, so that by placing a rule against the cut the dimensions of any of the apparatus mentioned can readily be obtained. Altogether the book appears to be a useful hand-book for the electrical manufacturer and the fitter who desires a thorough understanding of the various devices used in his work.

Electrical World Portraits—XXII.

WILLIAM CROOKES, F. R. S.

Few scientific men have had a more diversified career of research than William Crookes, now president of the Institution of Electrical Engineers. He was born in London in 1832, and when 16 years old entered the Royal College of Chemistry, then conducted by Professor Hoffman, perhaps to-day the greatest living chemist. Here he distinguished himself in his studies, and became successively the junior and senior assistant to Professor Hoffman. After leaving the Royal College of Chemstry he was appointed to superintend the meteorological department of the Radcliffe Observatory at Oxford. In the following year he began his independent academic career at the Science College, Chester, where he had charge of the chemical instruction. Still following the same line of studies, in 1859 he founded the *Chemical News*, the principal journal of chemical science published in England, of which he is still the proprietor. From 1864 to 1880, in addition, he conducted the *Quarterly Journal of Science*. Professor Crookes began his research work while still studying under Professor Hoffman, and for some years devoted himself mainly to inorganic chemistry, and especially investigated the element selenium, now so familiar to scientific electricians. His investigations on its compounds led him to examine certain sulphuric acid residues, and this work led, in 1862, to the discovery of the rare element, thallium, which brought Professor Crookes into notice at once. The following year he was elected Fellow of the Royal Society. Twenty-one years ago his first work on the phenomena of radiant energy, that has made his name so familiar, was begun.

He was led into this line of investigation by observations made while making determinations of weight in vacuo during his study of thallium. In 1873 his first memoir on this subject was presented to the Royal Society, and during the remainder of the decade he followed still other investigations. The radiometer was devised during this period. His researches on very high vacua made easier the questions involved in the construction of incandescent lamps in the early days of the art. His house was the first house in London to be fitted with the electric light, and the wiring was done by his own hands. At that time, in 1881, the carbon filaments were very inferior in quality, and Professor Crookes taking up the subject devised the process of dissolving cellulose in a strong solution of ammonium copper sulphate, drying up the solution into sheets, dissolving out the copper, and then carbonizing the horn-like layer of cellulose for filaments. The lamps thus constructed still remain in good working condition. In 1881 he acted as juror at the International Exhibition of Electricity in Paris; his system of lamps was consequently debarred from competing, but his fellow jurors remarked in their award in the four systems of lamps before them that none of them could have succeeded except for those extreme vacua which Professor Crookes has taught us to manage. In 1880 the French Academy of Science conferred on Professor Crookes the extraordinary prize of 3,000 francs and a gold medal, on account of his researches in vacua. Besides this he has received the gold medal of the Society of Arts and the Davy medal of the Royal Society. His contributions to physical science have been numerous and diversified, covering all sorts of topics from industrial chemistry to the highest flights of the pure physicist. His presidential address just published is a magnificent summary of the elaborate and beautiful researches that have occupied the last 20 years of his busy life.

PROF. WILLIAM CROOKES.

The Providence Electric Light Convention.

The following are the names of applicants for space at the Providence convention already received: New York Insulated Wire Company, New York City; Phœnix Glass Company, New York City; Washburn & Moen Manufacturing Company, Worcester, Mass.; Electric Engineering and Supply Company, Syracuse, N. Y.; Swarts & Gannett, Providence, R. I.; The Eddy Electric Motor Company, Windsor, Conn.; Jewell Belting Company, Hartford, Conn.; American Electrical Works, Providence, R. I.; Jenney Electric Motor Company, Indianapolis, Ind.: Interior Conduit and Insulation Company, New York City; James W. Queen & Co., Philadelphia, Pa.; Drake, Payson & Whittier, Providence, R. I.; The Okonite Company, New York City; The E. S. Greeley & Co., New York City; *Western Electrician*, Chicago, Ill.; Alexander, Barney & Chapin, New York City; H. T. Paiste, Philadelphia, Pa.; The Bryant Electric Company, Bridgeport, Conn.; Bernstein Electric Company, Boston, Mass.; T. M. Foote Regulator Company, Boston, Mass.; The Holtzer-Cabot Electric Company, Boston, Mass.; John Lynch, Washington, D. C.; The C. McIntire Company, Newark, N. J.; Eureka Tempered Copper Company, North East, Pa.; Standard Electric Supply Company, Boston, Mass.; Narragansett Electric Lighting Company, Providence, R. I.; The Johns-Pratt Company, Hartford, Conn.; Shultz Belting Company, St. Louis, Mo.; The Walker Electric Company, New York City; *Electric Power*, New York City; *The Electrical Engineer*, New York City; *Modern Light and Heat*, Boston, Mass.; Chas. A. Schieren & Co., New York City; Sperry Electric Light Company, Chicago, Ill.; Thomson-Houston Electric Company, Boston, Mass.; G. G. Stillman, Boston, Mass.

The exhibition will be held in Union Hall, Broad street, diagonally opposite from the hotel, which will be the headquarters of the association, and only one block from the building in which the sessions of the association will be held. The installation of exhibits may commence on Monday, Feb. 16, and all goods must be removed from the hall by 12 M. on Saturday, Feb. 21.

The several electric circuits will be brought into the hall, on the side as formerly announced; but the conveying of the same to different points in the hall as desired will be at the expense of the exhibitors and must be arranged for by them individually. The committee has arranged with the following parties, who are thoroughly competent and responsible, to attend to such business in their respective lines as may be intrusted to them by exhibitors, at reasonable rates.

Isaac A. Sherman, 7 Custom House street, on receipt of express receipts or bills of lading will transport goods to the hall, remove and store packing boxes, redelivering them on space at the close of the exhibition, also cart the goods back to the railroad depots for reshipment to exhibitors. Henry R. Barker, 45 Westminster street, will attend to all insurance desired on goods while on exhibition. John Battey, 82 Weybosset street, will attend to the erection of any counters, shelving, pavilions or railing desired. Timothy Heffernan, 50 Westminster street, will attend to all signs, lettering or show cards that may be wished for. Any one of the following parties in Providence will attend promptly to such wiring or other electrical construction as may be needed by exhibitors: Drake, Payson & Whittier, Washington and Eddy streets; George H. Thurston & Co., 59 South Main street; E. M. Carhart, 18 Custom House street; Swarts & Garnett, Swarts Building; Providence Construction Company, 20 Exchange Place; J. F. Hedge, Jr., 146 Westminster street.

All goods shipped for exhibition should be plainly marked with the name of the exhibitor himself. The chairman of the committee will upon application cheerfully furnish any further information or explain any point not fully understood.

The secretary of the Association has sent to the members a request to assist in carrying out a programme that has already been arranged for the celebration of the close of the first decade of the electric lighting industry. The members are urged to use their influence to secure the attendance of those interested in the industry at the beginning of the decade. The following persons have been invited to participate in this celebration, as the guests of the Association: Telegraphy, Dr. Norvin Green; ocean telegraphy, Cyrus W. Field; telephoning, Alexander Graham Bell; arc lighting, Chas. A. Brush; incandescent lighting. Thos. A. Edison; electric street railroad, Hon. Henry M. Whitney; electric welding, Prof. Elihu Thomson; technical education in electrical engineering, Gen. Francis A. Wolker; steam engineering for dynamo driving, Gardner C. Sims; organization of the National Electric Light Association, Geo. W. Worthington.

The morning session of the convention on Wednesday, the 18th, will be designated memorial session, and will be devoted exclusively to the recitation of such remembrances. All contributions will be published in the volume of proceedings after the convention, and will thus form a memorial of the beginnings of the various electrical industries.

President Marsden J. Perry, of the Association, will give a reception to the members at his residence at some time during the convention. The following is the committee of reception: Eugene F. Phillips, William G. Nightingale, Herbert Warren Ladd, Richard H. Deming, Albert C. White, James Richardson, Jr., George H. Wood, Gardner C. Sims, Henry A. DuVillard, Elisha Dyer, Isaac M. Potter, William S. Hayward, Homer M. Daggett, Jr., Mortimer H. Hartwell, William Ames, Henry R. Barker, Arthur H. Watson.

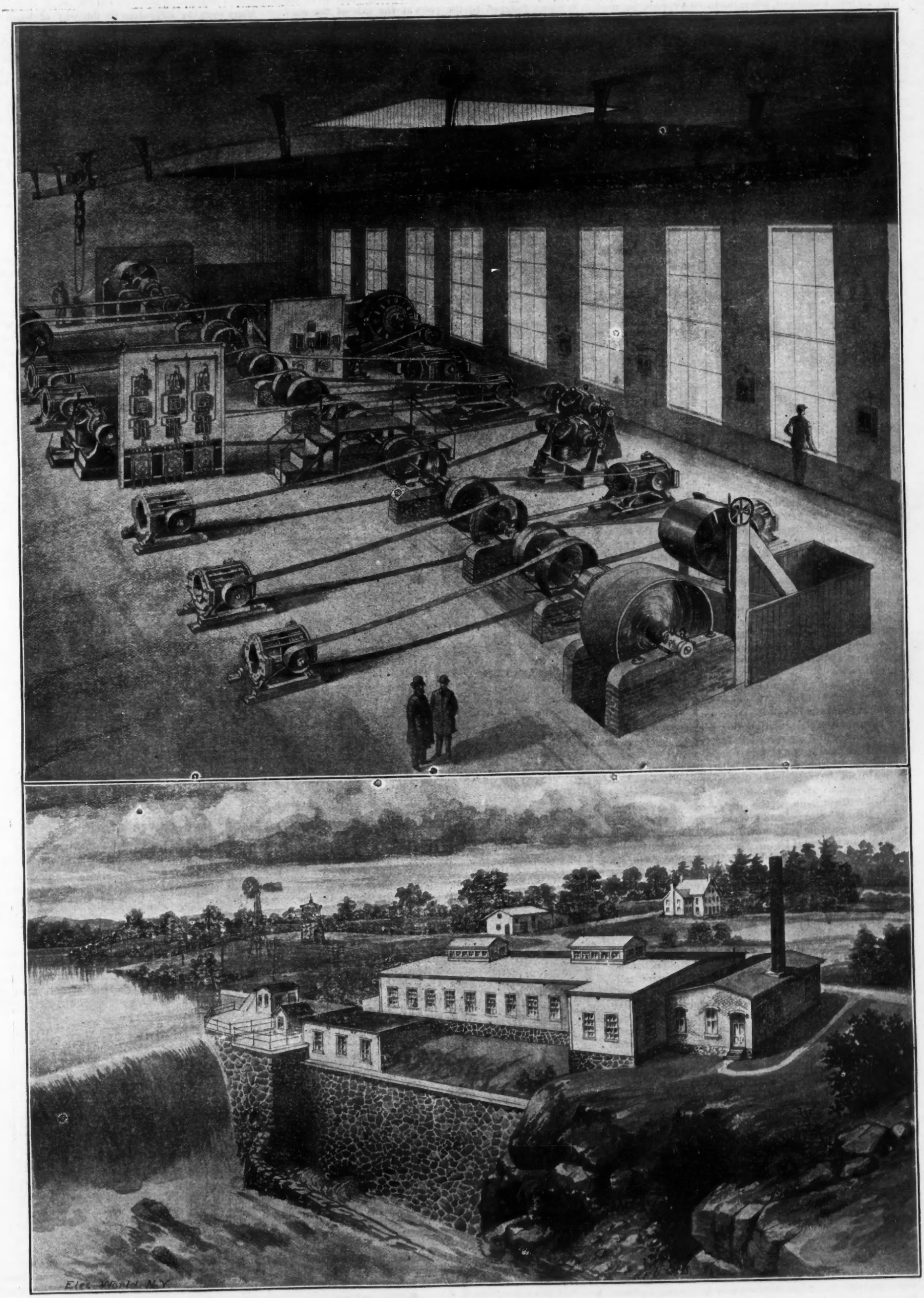
A New Hampshire Light and Power Station.

About seven miles from the town of Dover, on the Salmon Falls River, which divides the States of Maine and New Hampshire, is centered a most interesting enterprise. There, situated in the midst of a beautiful farm and park created by the company, is the station of the Dover Electric Light and Power Company, which supplies arc and incandescent lights, not only to the town of Dover, but to several distant towns, besides furnishing power for an electric street railway about seven miles in length.

As shown in the illustrations, the station is built upon the bank of the Salmon Falls River, at the side of the dam, which is the source of the water power used in the plant. The dynamo room is 50 × 100 feet in size, and the turbine wheel room and the engine room are each about 25 × 60 feet in size.

Running the full length of the dynamo room is a countershaft, divided in the centre by a clutch, from which are run the following generators: Nine 50-light Thomson-Houston arc dynamos, one 2,500-light Thomson-Houston alternating incandescent dynamo, two 65 h. p. and one 80 h. p. railway generators of the motor type.

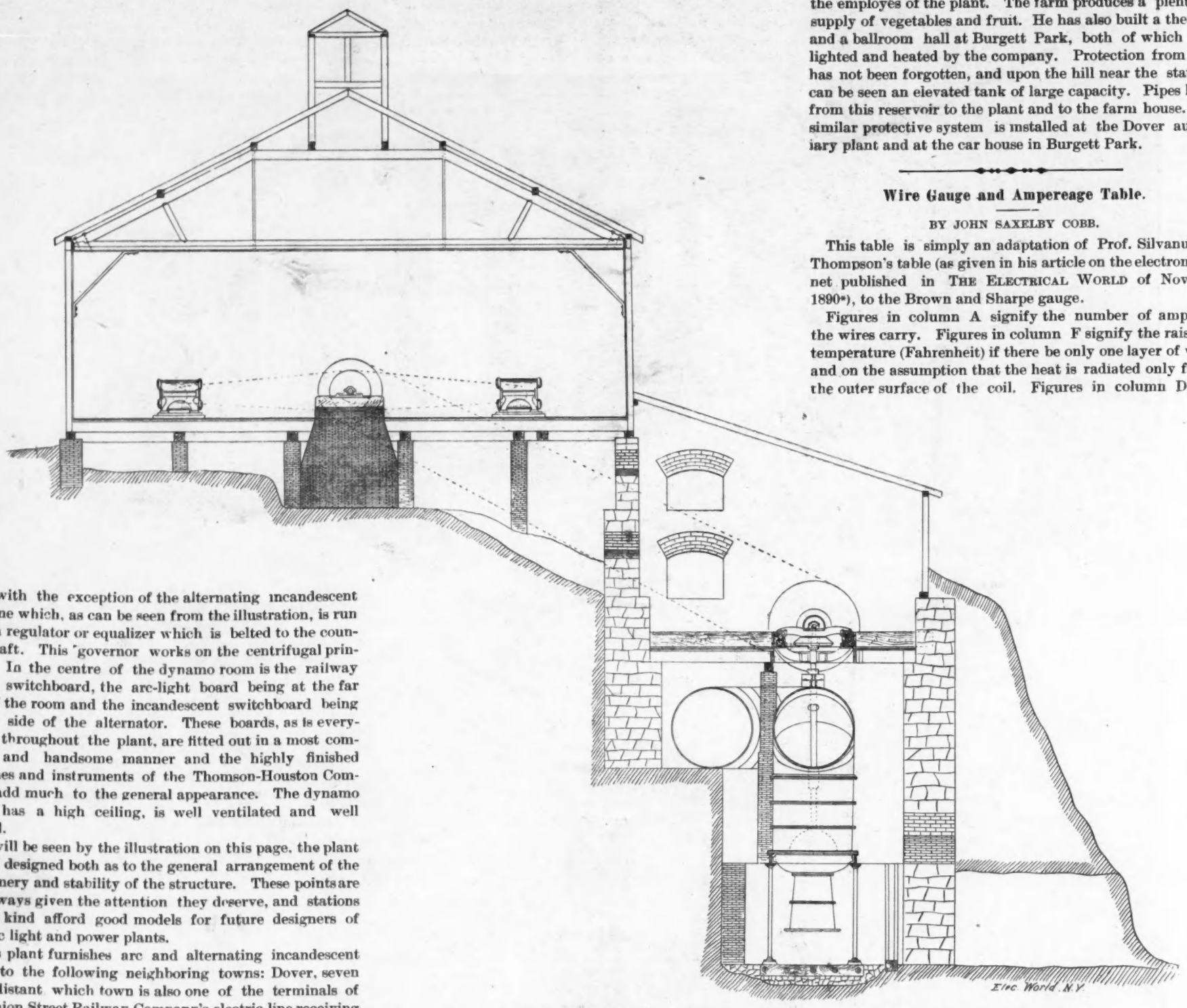
The engine and turbine wheel rooms are located at either end of the dynamo room, and to one end of the long countershaft in the latter room are belted two McIntosh and Seymour 250 h. p. compound condensing engines, which are coupled together. To the other end of the counter shaft is belted a turbine wheel of about 500 h. p. This wheel is used at all times to run the plant except when the water is low or when repairs are necessary. At each end of the long driving shaft is a clutch, thus permitting the operation of the plant either by water power or by the engines or both, and the clutch at the middle connecting the two halves of the counter shaft can be used to throw out either half of the machinery.



A NEW HAMPSHIRE ELECTRIC LIGHT AND POWER STATION.

At the extreme right end of the plant is the boiler room, which is built of brick. Steam, however, is only carried, as has been mentioned, when the turbine cannot be used. The engine room is at the end between the boiler and dynamo rooms.

All of the dynamos are run direct from the counter shaft with the exception of the alternating incandescent machine which, as can be seen from the illustration, is run from a regulator or equalizer which is belted to the counter shaft. This governor works on the centrifugal principle. In the centre of the dynamo room is the railway motor switchboard, the arc-light board being at the far end of the room and the incandescent switchboard being at the side of the alternator. These boards, as is everything throughout the plant, are fitted out in a most complete and handsome manner and the highly finished switches and instruments of the Thomson-Houston Company add much to the general appearance. The dynamo room has a high ceiling, is well ventilated and well lighted.



END ELEVATION OF DOVER ELECTRIC LIGHT AND POWER STATION.

As will be seen by the illustration on this page, the plant is well designed both as to the general arrangement of the machinery and stability of the structure. These points are not always given the attention they deserve, and stations of this kind afford good models for future designers of electric light and power plants.

This plant furnishes arc and alternating incandescent lights to the following neighboring towns: Dover, seven miles distant which town is also one of the terminals of the Union Street Railway Company's electric line receiving power from the same plant; Rochester and East Rochester, each about seven miles distant; Great Falls and Berwick, a double town divided by the river, one and a half miles distant; and North Berwick, six miles distant from the station. Besides the plant already described there are two more buildings belonging to this enterprising company. One is an auxiliary plant of two 50-light Thomson-Houston arc machines, and one 80 h. p. railway motor generator. This plant is run by three Armington & Sims 50 h. p. engines.

The arc dynamos at this plant are run continually together with the nine machines at the main station, but the motor generator is used as a reserve by the street railway. This was to be the nucleus of the whole system, but it was decided to build the large plant where water power was to be had. The other building is the car house where the reserve motor cars and road fittings are stored, and where quite a steam-heating plant is in operation for charging the cars with steam for heating and for supplying heat to two other buildings mentioned below. This building is midway between Dover and Great Falls, and is near the Burgett Park, owned by the company. This park is 40 acres in extent and was laid out as part of the enterprise by its originator, Mr. H. W. Burgett, who is president of the company.

The Union Street Railway Company is under the same ownership as the generating station, and runs between Dover and Great Falls, a distance of seven miles, using altogether about 12 cars, made by the Newburyport Car Company, of Newburyport, Mass., and mounted on Bemis trucks of seven-foot wheel base, and equipped with two 15 h. p. Thomson-Houston motors. The cars are heated in a most ingenious way, known as "steam charging." As the car is about to start on a trip from the car house a large charge of dry steam is put into the heater pipes under the seats. This charge keeps the car comfortably warm during one complete trip. These cars are very handsome, and reflect much credit upon the manager of the road, as well as upon the car company,

The pole line is a model for neatness and durability, and the trolley wire for the railway is suspended from side brackets, fastened to the poles at the side of the road. Upon the cross-arms above are carried a number of the electric light wires, varying in size from No. 00 to No. 6, and upon the topmost cross-arm are carried the telephone wires of the town. The trolley wire is of No. 0 hard-drawn copper wire and the feeders are all No. 00.

Mr. H. W. Burgett has not stopped short of anything that can contribute to the efficiency of the road and to the comfort and convenience of the passengers, and in each car are two clocks, one at either end.

When this enterprise was first proposed it was pronounced by a majority to be impracticable, but owing to the engineering abilities of Mr. Burgett, who had been for some time connected with the Thomson-Houston Electric Company at Lynn, Mass., the scheme has been a pronounced success.

Many were the difficulties in the way of locating the plant at the river side, and much blasting of the rocky ground had to be done. Not stopping at this, Mr. Burgett has started a farm at the site of the station and has built ample accommodations for the families of all o the employés of the plant. The farm produces a plentiful supply of vegetables and fruit. He has also built a theatre and a ballroom hall at Burgett Park, both of which are lighted and heated by the company. Protection from fire has not been forgotten, and upon the hill near the station can be seen an elevated tank of large capacity. Pipes lead from this reservoir to the plant and to the farm house. A similar protective system is installed at the Dover auxiliary plant and at the car house in Burgett Park.

Wire Gauge and Ampereage Table.

BY JOHN SAXELBY COBB.

This table is simply an adaptation of Prof. Silvanus P. Thompson's table (as given in his article on the electromagnet published in The Electrical World of Nov. 8, 1890*), to the Brown and Sharpe gauge.

Figures in column A signify the number of ampères the wires carry. Figures in column F signify the raise in temperature (Fahrenheit) if there be only one layer of wire and on the assumption that the heat is radiated only from the outer surface of the coil. Figures in column D are the depth to which the wire may be wound if one watt be lost per square inch of radiating surface, the outer surface only being considered. There has been added to the diameter of the bare wire 10 mils for double cotton cov-

WIRE GAUGE AND AMPEREAGE TABLE.

B. & S. gauge.	Dimensions. Diameter in mils, bare.	D² = circular mils.	Sectional area in sq. inches, bare.	Turns to one linear inch double cotton covered.	Turns per sq. inch double cotton covered.	Ohms per cubic inch double cotton covered.	Permissible Ampereage, Probable Heating, and Permissible Depth. At 1,000 ampères to square inch. A.	F.	D.	At 2,000 ampères to square inch. A.	F.	D.	At 3,000 ampères to square inch. A.	F.	D.	At 4,000 ampères to square inch. A.	F.	D
5	181.940	33102.0	.026015	5.20	29.74	.0008077	26.015	21.50	2.2	52.03	86.00	.55	78.045	193.50	.245	104.06	344.00	.138
6	162.020	26250.5	.020612	5.81	37.13	.0012717	20.612	19.04	2.23	41.224	76.16	.558	61.836	171.36	.248	82.448	304.64	.139
7	144.280	20816.0	.016331	6.49	46.33	.0020037	16.331	16.87	2.36	32.662	67.48	.59	48.993	151.83	.262	65.324	269.92	.148
8	128.490	16509.0	.012948	7.24	57.66	.0031324	12.948	15.50	2.20	25.896	62.00	.55	38.844	140.50	.245	51.792	248.00	.138
9	114.430	13094.0	.010274	8.07	71.63	.0049209	10.274	13.18	2.31	20.548	52.72	.578	30.822	118.62	.257	41.096	210.88	.145
10	101.890	10381.0	.008139	8 93	87.72	.0076316	8.139	11.60	2.39	16 278	46.40	.598	24.417	104.40	.265	32.556	185.60	.149
11	90.742	8234.0	.006461	9.93	108.46	.0118492	6.461	10.20	2.42	12.922	40.80	.605	19.383	91.80	.269	25.844	163.20	.151
12	80.808	6529.9	.005127	11.38	142.45	.0196224	5.127	9.25	2.34	10.254	37.00	.585	15.381	83.25	.260	20.508	148.0	.146
13	71.961	5178.4	.004058	12.21	163.99	.028485	4.058	7.87	2.57	8.116	31.48	.642	12.174	70.83	.285	16.232	125.92	.160
14	64.084	4106.8	.003216	13.51	200.77	.0429686	3.216	6.90	2.65	6.432	27.60	.662	9.648	62.10	.294	12.864	110.40	.165
15	57.068	3256.7	.002551	14.92	244.86	.0675813	2.551	6.06	2.73	5.102	24.24	.682	7.653	54.54	.303	10.204	96.96	.170
16	50.820	2582.9	.002026	16.44	297.28	.103452	2.026	5.29	2.84	4.052	21.16	.710	6.078	47.61	.315	8.104	84.64	.177
17	45.257	2048 2	.001604	18.18	363.56	.1596028	1.604	4.63	2.93	3.208	18.52	.732	4.812	41.67	.325	6.416	74.08	.183
18	40.303	1624.3	.001275	19.88	395.21	.217847	1.275	4.03	3.08	2.550	16.12	.770	3.825	36.27	.342	5.100	64.48	.192
19	35.390	1252.4	.000984	22 03	532.85	.353394	.984	3.44	3.25	1.968	13.76	.812	2.952	30.96	.361	3.936	55.04	.203
20	31.961	1021.5	.000799	23.83	624.65	.550004	.799	3.02	3.43	1.598	12.08	.858	2.397	27.18	.381	3.196	48.32	.215
21	28.462	810.1	.000633	26.00	743.60	.825582	.633	2.61	3.55	1.266	10.44	.888	1.899	23.49	.394	2.532	41.76	.222
22	25.347	642.7	.000502	28 23	876.62	1.226391	.502	2 25	3.89	1.004	9.00	.972	1.506	20.25	.432	2.008	36.—	.243
23	22.571	509.45	.000397	30.70	1036.73	1.830243	.397	1.93	4.16	.794	7.72	1.04	1.191	17.37	.462	1.588	30.88	.260
24	20.100	404.01	.000317	33.22	1213.92	2.702186	.317	1.67	4 45	.634	6.68	1.112	.951	15.03	.494	1.268	26.72	.278
25	17.900	320.4	.00 251	35.84	1412.95	3.96615	.251	1.43	4.82	.502	5.72	1.205	.753	12.87	.535	1.004	22.88	.301
26	15.940	254.01	.000198	38.55	1636.91	5.794252	.198	1 21	5.30	.396	4.84	1.325	.594	10.89	.589	.792	19.36	.331

ered, and in turns per square inch 10 per cent. has been added for the bedding of wires. The column headed "ohms per cubic inch" is calculated for copper of 100 per cent. conductivity.

*See "The Electromagnet" by Prof. S. P. Thompson, p. 178, for the same table.

Statistics of the West End Street Railway.

At a recent hearing before the Massachusetts State Railroad Commissioners, at which the West End Street Railway Company of Boston sought permission to increase its capital stock by the issue of 90,000 shares, of the par value of $50 each, some interesting facts and figures were presented.

In making the last application for increase of capital the company filed an inventory of its property and assets as of Sept. 30, 1888, supplemented by a statement of its condition brought down to June 30, 1889, together with an estimate of further construction and equipment expenditures dating from Sept. 3, 1888, for which new capital was asked, the total of such expenditures being stated at $4,783,216.27. Beginning with these valuations, the charges in fixed property accounts from Sept. 30, 1888, to Sept. 30, 1890, were presented in a detailed statement.

The following were the important items: Total increase for track construction, $557,142.22; electric cars and motors, $1,303,175.64; general equipment, $64,064.45; total for electric construction, $1,890,380.56; making a total up to Sept. 30, 1890, of $3,677,724.16; additions in October and November, 1890, $321,141.18; making the total additions to fixed property account since inventory of Sept. 30, 1888, to Nov. 30, 1890, $3,998,865.34.

The total fixed property accounts Sept. 30, 1888, amounted to $11,806,824.23. At that date the capitalization was $6,821,100. The balance of fixed property account represented by floating debt is $1,871,689.57. The last issue of stock authorized was $4,000,000, of which there remains to be issued $2,000,000; amount of the same unexpended, $128,310.43.

The estimated construction expenditures for which new stock is required are: Central power station, estimated amount required to complete construction and equipment, $1,200,000; East Cambridge power station, estimated amount to complete construction and equipment, $650,000; line construction and equipment, $500,000; track construction at $7,500 per mile for betterment in rails, $500,000; new electric car houses, $250,000; electric cars, 600 at $4,000 each, $2,400,000; making a total of $5,500,000. Mr. Goodspeed testified that the statement of estimates had been made up from his books. The company has made the actual expenses as set forth in the statement.

New Thomson-Houston Slow Speed Railway Motor.

We illustrate on this page a new motor which the Thomson-Houston Electric Company has been at work upon for some time, and with two of which a car on the West End road in Boston has recently been equipped. It has been named, from its construction, the "single reduction gear" motor, but is ordinarily called the "S. R. G." As will be seen in Fig. 1, the motor is very nearly iron clad, having two pole pieces of ample surface and carrying two field coils, which partially surround the armature core. The magnetic circuit is completed on the front end of the motor through the face plate and at the back through the frame on which are cast the axle boxes and arms which serve as a support for the ar mature shaft bearings. The armature is of the Gramme ring type, and the bobbins are wound close together around the entire rim, Fig. 2. One great advantage of this construction is the fact that any coil can be easily rewound without disturbing its fellows, while with the drum armature in the type of motor formerly used by the company the winding all had to be renewed down to the injured coil.

The brushes are placed exactly opposite and in a horizontal fixed position. There seems to be no sparking under the ordinary running conditions, and the brushes are easy of access.

The field spools are protected on all sides by the fields and frame. The gears are entirely inclosed in a dust and oil-tight case, which is provided with a hand-hole closed by a spring cover, permitting ready examination of gears and the introduction of lubricants.

A sheet-iron pan extending above the centre of the armature shaft entirely incloses the bottom and sides of the motor and protects the armature and commutator from dust, snow and water. The advantage of this casing was strikingly demonstrated during the recent snow storms, the "S. R. G." coming through unharmed, while some of the fields on the old style of motor came to grief from the effects of excessive moisture. This pan has a sliding bottom, and is attached to the motor in such a manner as to permit of being readily removed for access to the various parts.

The motor when mounted on a truck with thirty-inch wheels is designed to clear the tops of the rails four inches. The spur gear on the armature shaft is of steel, four and one-half inches face, and has 14 teeth. The split gear on the car axle is of cast iron, with the same width of face, and has 67 teeth. The speed of the armature shaft relative to that of the car axle is nearly as 4.8 to 1; when the car is running ten miles per hour the armature makes 538 revolutions per minute, or the speed of the armature is 53.8 turns per minute when the car speed is one mile per hour. The gears are surrounded by an iron box so that they may be run in oil.

The facility with which the armature can be removed simply by lifting the upper field, the ease with which an armature bobbin can be rewound, less liability to damage from centrifugal action, such as bursting of binding wires, displacement of coils, breaking of commutator connections, all insure a minimum amount of expenditure for repairs.

The accompanying illustrations show very plainly the general appearance and detailed construction of the motor. The advantages claimed by the designers have been summarized as follows:

1. Noiseless single reduction gears, protected from dust and run in oil, and noiseless commutator. 2. Electrical and mechanical simplicity attained by use of two-pole type of motor. 3. Slow speed and powerful torque obtained by proper proportions. 4. Protection for fields and armature from dust and water. 5. Accessibility to all parts. 6. A ring armature not likely to become damaged, and, if accidently injured, permitting easy repairs. 7. Moderate weight. 8. Reasonable cost. 9. Commercial efficiency. 10. Small maintenance expense.

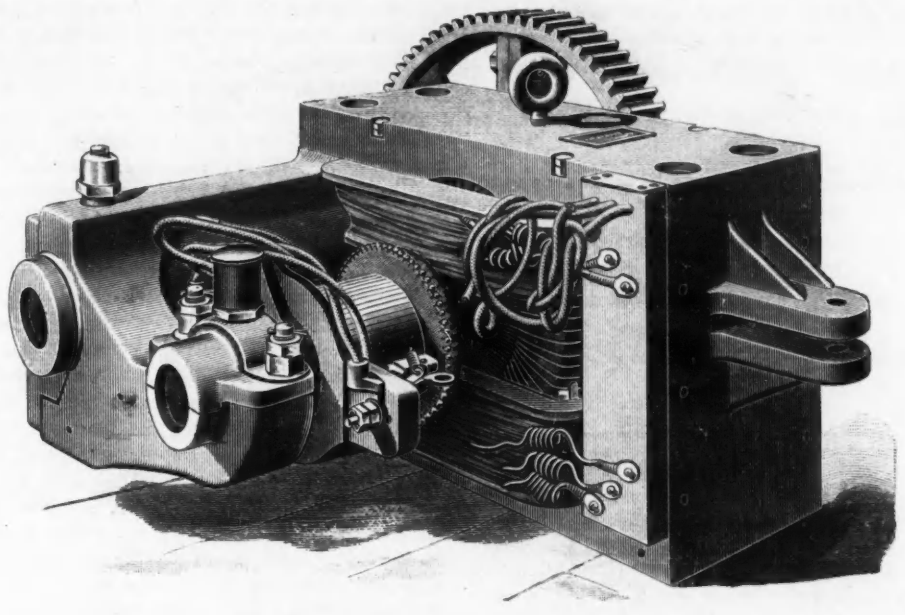


FIG. 1.—THOMSON-HOUSTON SLOW SPEED MOTOR.

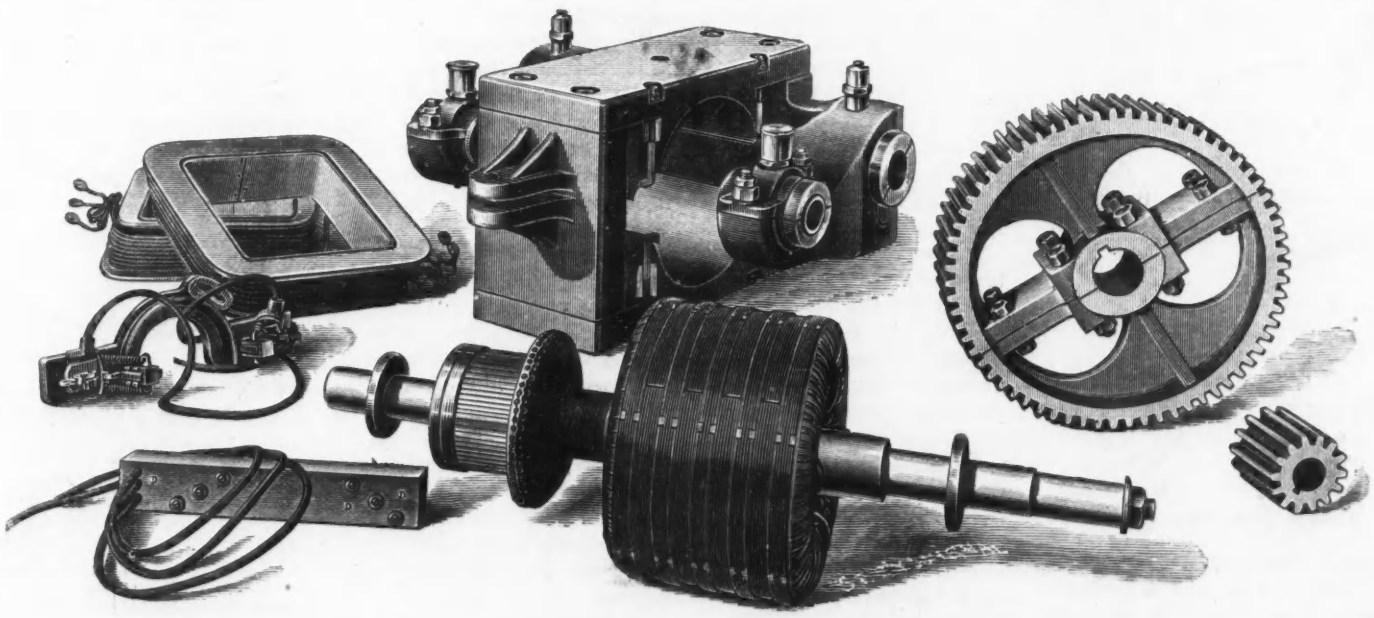


FIG. 2.—DETAILS OF THE THOMSON-HOUSTON SLOW SPEED MOTOR.

The German Telegraph Tariff.

On the advice of Herr von Stephan, the German Government has reduced the tariff for inland telegrams from six to five pfennigs a word, with a minimum charge of 50 pfennigs, or sixpence. Herr von Stephan has, however, resisted all demands for a tariff for press telegrams similar to that existing in England. Speaking recently before the Budget Committee of the Reichstag, Herr von Stephan, in the name of the Federal Government, declared that he saw no good and sufficient reason to yield to the demand of the 234 newspapers which had petitioned for a reduced tariff for press telegrams. These newspapers, he said, had already enjoyed advantages enough in the lowness of the rates for their postal transmission, as well as in the comparative cheapness of the wires of which they might have the special use at night. Of over 14 million telegrams that were last year sent and delivered within the Empire, only 1.29 per cent. were press messages, representing a revenue to the State of about 153,000 marks.

Street Railway Progress in Rochester, N. Y.

At the annual meeting of the stockholders of the Rochester Street Railway Company, held recently, a detailed report was presented of the work of construction of the electric lines now in operation or in process of construction. It will be remembered by our readers that this immense plant, which is, next to Boston, perhaps, the largest electric street railway installation in the country, was recently fully described and illustrated in THE ELECTRICAL WORLD.

The report to the stockholders was a satisfactory one, and it was announced as the intention of the company to continue the equipment of its lines until the entire system was supplied with electric power. The Lyell avenue line is now about ready for operation, the cars for this line being already in the company's car houses. When this has been put in operation the company will give its attention to the equipment of the Monroe avenue line. The election of directors by the stockholders resulted in the choice of the following:

H. Sellers McKee, Pittsburgh; M. R. Verner, Buffalo; E. E. Denniston, Richard M. Clay, Horace Magee, T. De Witt Cuyler, Philadelphia; Benjamin Graham, New York;

A. G. Yates, Frederick Cook, W. S. Kimball, A. Luetchford, M. H. Briggs, J. N. Beckley, Rochester.

The officers chosen were as follows: J. N. Beckley, president; Benjamin Graham, vice-president; Arthur Luetchford, secretary and treasurer, C. K. Minary, general manager.

Mr. Beckley, the president, is a member of the syndicate which controls street railways in Buffalo and in Bridgeport, Conn., the consolidation of roads in the latter place being recently made under his supervision. He was one of the organizers of the present street railway company in Rochester and negotiated the purchase of the road from its former owners. The law firm of which he is a member is that of Bacon, Briggs & Beckley.

Electricity in Transitu: from Plenum to Vacuum.*

BY PROF. WILLIAM CROOKES, F. R. S.

INTRODUCTION.

While steadily bearing in mind that I have the honor to address a society, not only of physicists, but of electrical

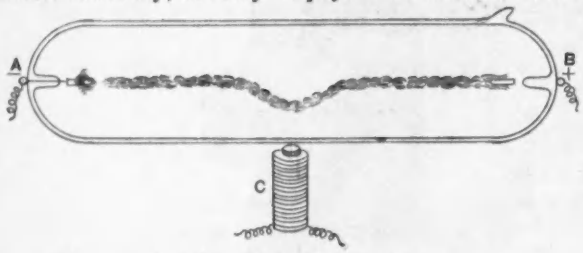


FIG. 1.—P = 75 MM.

engineers, I shall not, I hope, be out of order in venturing to call your attention to a purely abstract phase of electrical science. Numberless instances show that pure research is the abundant source from which spring endless streams of practical applications. We all know how speculative inquiry into the influence of electricity on the nervous systems of animals led to knowledge of current electricity, and ultimately to the priceless possession of the telegraph and the telephone. The abstract study of certain microscopic forms of parasitic vegetable life has enabled us to give to fermented solutions of sugar the exact flavor and aroma of the most highly prized wines, and probably, ere long, will put us in a position to increase at will the fertility of the soil. In a different direction the same class of abstract researches applied to medical science has brought us within measurable distance of the final conquest over a large class of diseases hitherto incurable; and without egotism I may, perhaps, be allowed to say that my own researches into high vacua to some extent have contributed to the present degree of perfection of the incandescent lamp. Surely, therefore, while eagerly reaping and storing the harvest of practical benefits, we must not neglect to scatter more seed for future results, perchance not less wonderful and valuable.

In another respect I deviate to some extent from the course taken by many of my predecessors. I am about to treat electricity, not so much as an end in itself, but rather

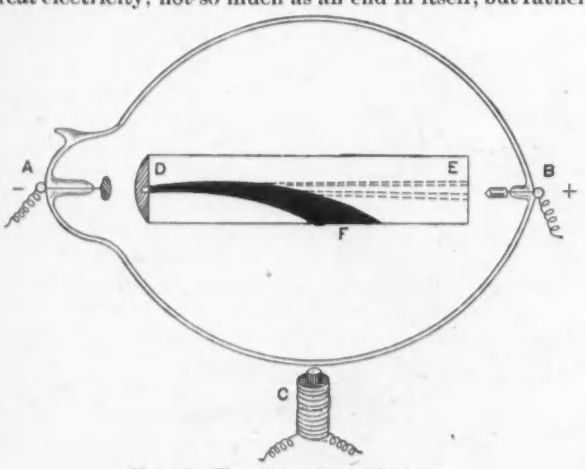


FIG. 2.—P = 0.1 MM. = 131.5 M.

as a tool, by whose judicious use we may gain some addition to our scanty knowledge of the atoms and molecules of matter, and of the forms of energy which by their mutual reactions constitute the universe as it is manifest to our five senses.

I will endeavor to explain what I mean by characterizing electricity as a tool. When working as a chemist in the laboratory, I find the induction spark often of great service in discriminating one element from another, also in indicating the presence of hitherto unknown elements in other bodies in quantity far too minute to be recognizable by any other means. In this way chemists have discovered thallium, gallium, germanium, and numerous other elements. On the other hand, when examining electrical reactions in high vacua, various rare chemical elements become in turn tests for recognizing the intensity and character of electric energy. Positive and negative electricity effect respectively different movements and luminosities. Hence the behavior of the substances upon which electricity acts may indicate with which of these two kinds we have to deal. In other physical researches both electricity and chemistry come into play simply as a means of exploration.

In submitting to you certain researches in which electricity is used as a tool, or as a means of bringing within scope of our senses phenomena that otherwise would be unrevealed, I must for a moment recall to your minds the now generally accepted theory of the constitution of matter.

* Presidential address before the Institution of Electrical Engineers, London.

KINETIC THEORY OF GASES.

Matter, at its ultimate degree of extension, is conjectured to be not continuous, but granular. Maxwell illustrates this view as follows: To a railway contractor driving a tunnel through a gravel hill, the gravel may be viewed as a continuous substance. To a worm, wriggling through gravel, it makes all the difference whether the creature pushes against a piece of gravel or directs its course between the interstices. To the worm, therefore, gravel seems by no means homogeneous and continuous.

With speculations as to the constitution of liquid and solid matter I need not trouble you, but will proceed at once to the third or gaseous state of matter.

The kinetic theory of gases teaches that the constituent molecules dart in every possible direction with great but continually varying velocities, coming almost ceaselessly in mutual collision with each other.* The distance each molecule traverses without hitting another molecule is known as its *free path;* the average distance traversed without collision by the whole number of molecules of a gas at any given pressure and temperature is called the *mean free path.* The molecules exert pressure in all directions, and are only restrained by gravitation from dissipating themselves into space. In ordinary gases, the length of the mean free path of the molecules is exceedingly small compared with the dimensions of the vessel, and the properties we then observe are such as constitute the ordinary gaseous state of matter, which depends upon constant collisions. But if we greatly reduce the number of molecules in a given extent of space the free path of the molecules under electric impulse is so long that the number of their mutual collisions in any given time in comparison with the number of times they fail to collide may be disregarded. Hence, the average molecule can carry out its own motions without interference. When the mean free path becomes comparable to the dimensions of the containing vessel, the attributes which constitute gaseity shrink to a minimum, the matter attains the ultra-gaseous or "ra-

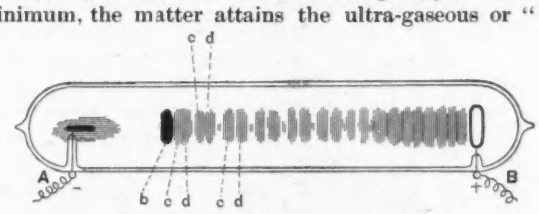


FIG. 3.—P = 2.0 MM. = 2,630 M.

diant" state, and we arrive at a condition where molecular motions under electrical impulse can easily be studied.

The mean free path of the molecules of a gas increases so rapidly with progressive exhaustion, that while that of the molecules of air at the ordinary pressure is only 1-10,000th of a millimetre, at an exhaustion of a hundred-millionth of an atmosphere—a point (which with present appliances is easy to attain) corresponding to the rarefaction of the air 90 miles above the earth's surface—the mean free path will be about 30 feet; while at 200 miles above the earth it will be 10,000,000 miles, and millions of miles out in the depths of space it will become practically infinite. I could go on speculating in spite of Aristotle, who said: "Beyond the universe there is neither space, nor vacuum, nor time."

In discussing the motions of molecules we have to distinguish the *free* path from the *mean free path.* Nothing is yet known of the *absolute* length of the free path nor of the *absolute* velocity of a molecule. For anything we can prove to the contrary, these values may vary almost from zero to infinity. We can deal only with the *mean* free path and the *mean* velocity.

THE VACUUM PUMP.

As most of the experiments I put before you to-night are connected with high vacua, it is not out of place to refer to the pump by means of which these tubes are exhausted. Much has been said lately in recommendation of the Geissler pump and its many improvements, but I am still strongly in favor of the Sprengel, as with it I have obtained greater exhaustion than with any other. I should like to point out that the action does not stop when we cease to see air specks passing down the tubes, but continues long after this point has been passed. Neither is the non-conducting vacuum, so easily obtained by the Sprengel pump, due in any way to the presence of mercury vapor, since non-conduction can be obtained just as rapidly when special precautions have been taken to keep mercury vapor out of the tubes.

One of the great advantages of the Sprengel pump over all others lies in the fact that its internal capacity need not exceed a few cubic centimetres, and there is, therefore, much less wall surface for gases to condense upon. I have brought the very latest modification of this form of pump here to-night, and you will have an opportunity of seeing it in action and of measuring with the McLeod gauge the rarefaction it produces.

* I speak of "collisions," as these are the generally accepted *substrata* of the kinetic theory. But Prof. Silvanus P. Thompson reminds me that Boltzmann some years ago proposed a modification of the kinetic theory which to me seems a vast improvement on the somewhat bald notion of molecular collisions. According to Boltzmann's view, in a so-called "collision" the molecules do not actually bounce against one another, but merely fly round in two interlocking hyperbolic paths. The effect, for all external purposes will be the same as if they collided, because of the extreme minuteness of the curved part of the paths. The gain in thus regarding the matter is that such hyperbolic paths are quite consistent with obedience to the ordinary laws of gravitational attraction; whereas the collision theory needs for its explanation that when molecules come very near together they should exhibit a repulsion varying inversely as the fifth power of the distance between them.

THE PASSAGE OF ELECTRICITY THROUGH RAREFIED GAS.

The various phenomena presented when an induction spark is made to pass through a gas at different degrees of exhaustion point to a modified condition of the matter at the highest exhaustions. Here are three exactly similar bulbs, the electrodes being aluminium balls, and the internal pressures being respectively 75 millimetres, 2 millimetres and 0.1 millimetre. If I pass the induction current in succession through the bulbs, you will perceive in each case very different luminous phenomena. Here is a slightly exhausted tube (Fig. 1), like the first in the series just exhibited (75 millimetres); the induction spark passes from one end to the other, *A*, *B*, and the luminous discharge is seen as a line of light, acting as a flexible conductor. Under the tube I have an electromagnet, *C*, and on making contact the line of light dips in the centre down to the poles of the magnet, and then rising again proceeds

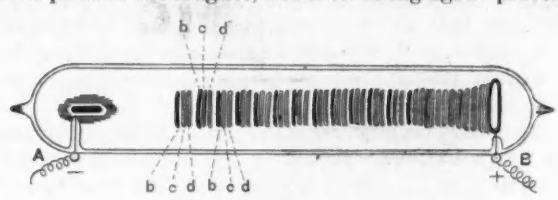


FIG. 4.—P = 2.0 MM. = 2,630 M.

in a straight line. On reversing the current the line of light curves upward. Notice that the action of the magnet in this case is only local.

In a highly exhausted tube the action is quite otherwise. Such a tube is before you (Fig. 2), and in it I have carried the exhaustion to a high point (0.1 millimetre). I pass the induction current, and you perceive the electrified molecules, like the line of light in the first tube, also move in straight lines, and make their path apparent by impinging on a phosphorescent screen, *D E.* If, however, I submit them to the action of a magnet, c, their behavior is different. The line dips down to *F*, but does *not* recover itself. It seems that in the tube first shown we have to do with the average behavior of the molecules of gas in its totality. In the second case, where the gas has been greatly attenuated, we are merely concerned with the behavior of the individual molecules of which it was originally composed.

THE STRATIFIED DISCHARGE.

When the gas is rarer than is necessary to give the flexible line of light, as shown in the first experiment, the luminosity is plainly discontinuous or, as it is termed, stratified.

A very good illustration of this fact may be taken from the moving crowd in any such frequented street, say Fleet street. If, at some time when the stream of traffic runs almost equally in both directions, we take our stand at the window from which we can overlook the passing crowd, we shall notice that the throng on the foot-way is not uniformly distributed, but is made up of knots—we might almost say blocks—interrupted by spaces which are comparatively open. We may easily conceive in what manner these knots or groups are formed. Some few persons

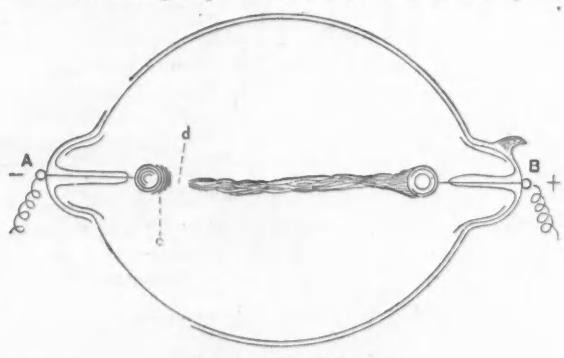


FIG. 5.—P = 6.0 MM.

walking rather more slowly than the average rate slightly retard the movements of others whether traveling in the

* My measurements of high vacua have all been taken with the beautiful little gauge devised by Professor McLeod. Unmerited discredit has recently been cast on this gauge, the principal fault alleged being its inability to distinguish between the tension of the permanent gas and that of the mercury vapor present. Now it is evident that, under ordinary circumstances, the tension of mercury vapor may be disregarded, as it will be the same on both sides of the gauge; and it will be only in cases where no mercury is present on one side of the gauge that a slight error is introduced. It is, however, very difficult to devise and successfully experiment with apparatus in which a trace of mercury vapor shall not enter, and it is not likely that an experimentalist who would be working with such mercury free apparatus would attempt to use the gauge without remembering that in this special case the indications would be incorrect. To use the McLeod gauge requires much patience and some amount of experience, but I have always found it trustworthy to register exhaustions far beyond the millionth of an atmosphere. I can adduce circumstantial evidence of the accuracy of its readings at these high vacua. In the year 1881 I read a paper before the Royal Society on "The Viscosity of Gases at High Exhaustions" (*Phil. Trans.*, 1881, p. 387), and illustrated my results in three large diagrams, on which I plotted the experimental results obtained at rarefactions up to the 0.02 millionth of an atmosphere, giving curves comparing the decrease in viscosity with that of the repulsion resulting from radiation, at the different pressures. Now these curves, in the case of air, for instance, are perfectly regular and uniform in their falling off, and it is evident that this could not have been the case unless the abscissæ representing viscosity and the ordinates representing pressure were equally accurate. I am satisfied that, within narrow limits, the abscissæ of viscosity are correct to the highest point, and the conformity of experiment to theory in the shape of these curves is a conclusive proof that, at as high an exhaustion as 0.02 M., the McLeod gauge is to be trusted to give accurate results within two per cent. of the truth. To give some idea what these high exhaustions mean, I may mention that the highest measured exhaustion (0.02 M.) bears the same proportion to the ordinary pressure of the atmosphere that a millimetre does to 30 miles, or, in point of time, that one second bears to 0.30 month.

same or in an opposite direction. Thus a temporary obstruction is created. The passengers behind catch up to the block and increase it, and those in front, passing on unchecked at their former rate, leave a comparatively vacant space. If a crowd is moving all in the same direction the formation of these groups becomes more distinct. With vehicles in crowded streets, the result, as every one may have remarked, will be the same.

Hence mere differences in speed suffice to resolve a multitude of passengers into alternating gaps and knots.

Instead of observing moving men and women, suppose we experiment on little particles of some substance, such as sand, approximately equal in size. If we mix the particles with water in a horizontal tube and set them in rhythmical agitation, we shall see very similar results, the powder sorting

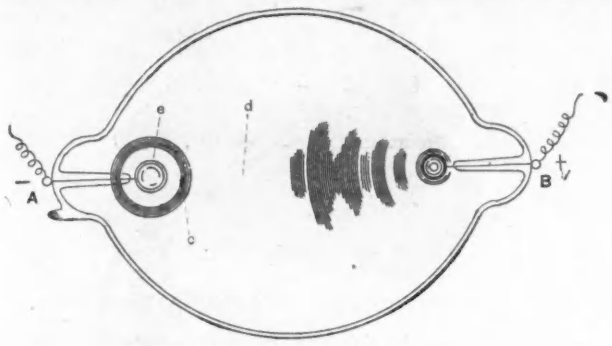


FIG. 6.—P = 3.0 MM.

itself with regularity into alternate heaps and blank spaces.

If we pass to yet more minute substances, we observe the behavior of the molecules of a rarefied gas when submitted to an induction current. The molecules here are free, of course, from any caprice, and simply follow the law I seek to illustrate, and though originally in a state of rampant disorder, yet under the influence of the electric rhythm they arrange themselves into well defined groups or stratifications: the luminosities show where arrested motion with concomitant friction occurs, and the dark intervals indicate where the molecules travel with comparatively few collisions.

PARTY-COLORED STRATIFICATIONS.

As another illustration of stratifications in a moderately exhausted tube ($P = 2$ millimetres). I will take the case of hydrogen prepared from zinc and sulphuric acid after being passed through various purifying agents, dried in the usual manner, and exhausted with a mercury pump (Fig. 3). I pass the induction current, and we see that the stratifications are tricolored, blue, pink and gray. Next the negative pole A is a luminous layer, then comes a dark interval or Faraday's dark space (see below), and after this are the stratifications, the front component (b) of each group blue, the next (c) pink, and the third (d) gray. The blue discs are somewhat erratic. At a certain stage of exhaustion all the blue components of the stratifications suddenly migrate to the front, forming one bright blue disc, and leaving the pink and gray components by themselves. The tube before you (Fig. 4) is at this particular stage of exhaustion, and on passing the current you observe the blue disc only (b) is in front. When the tube contains a compound gaseous residue of this kind, the form of stratifications can be very considerably altered by varying the potential of the discharge. This alteration in the forms of stratification was first pointed out by Gassiot (1865, "B. A. Abstracts," p. 15), who gave very full descriptions and drawings of the alterations produced by putting in resistances of various lengths of distilled water. That the alteration depends simply upon the difference of potential the following experiment pretty clearly shows: Here is a tube giving on my coil the colored stratification usually attributed to the presence of residual hydrogen, but which I find is due to a

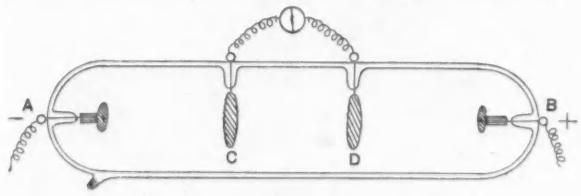


FIG. 7.

mixture of hydrogen, mercury, and hydro-carbon vapors. Now, by altering the break so as to produce frequent discharges of lower potential, you see the stratifications gradually change in shape and become all pink; again altering the break so as to send less rapid discharges at a much higher potential, once more we get the colored stratifications. When in this state, if we introduce a water resistance into the circuit so as to damp down the potential, exactly the same thing happens. The blue disc is caused by mercury; its spectrum is that of mercury only, without even a trace of the bright red line of hydrogen. Experiments not yet finished make it very probable that the pink discs are due to hydrogen, and that the gray discs indicate carbon. The tube you have just seen contains nothing but hydrogen, mercury, and a minute trace of carbon; but with all the resources at my command I have not been able to get hydrogen quite free from impurity. Indeed, I do not think absolutely pure hydrogen has ever yet been obtained in a vacuum tube. I have so far succeeded as to completely eliminate the mercury, and almost completely to remove the trace of carbon. On the table is such a tube giving uniformly pink stratifications, and showing no blue or gray discs with any potential of current.

THE DARK SPACE.

After the stratification stage is passed, we come to a very curious phenomenon, the so-called "dark space." Studying electrical phenomena in gases, in the year 1838, Faraday* pointed out a break in the continuity of the luminous discharge separating the glow of the positive electrode from that of the negative. This he called "the dark space." It is seen in tubes containing gas only slightly rarefied, as in this tube (Fig. 5, $P = 6$ millimetres), where you will observe that the positive glow, extending as a pink streak from the positive electrode B ends about 10 millimetres before the spot of blue light C, representing the negative glow. This gap, or non-luminous hiatus, D is Faraday's "dark space." Separating the negative glow from its electrode is another space. In this tube it is so small that the glow appears to be in actual contact with the electrode, but on exhausting a little further it rapidly separates; and in the next tube (Fig. 6), containing air at a little less pressure ($P = 3$ millimetres), this dark space E has extended so as to remove the negative glow about four millimetres from the electrode A. It is with this second dark space that I particularly wish to deal to-night. Therefore I shall refer to it as the "dark space," meaning always that in a negative glow.

In the experiment just shown with hydrogen stratifications the contents of the tube under the electric discharge

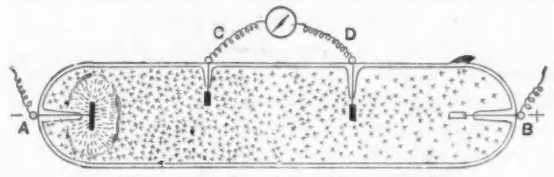


FIG. 8 A.—P = 0.25 MM. = 330 M.

still obey the laws following from the average properties of an immense number of molecules moving in every direction with velocities of all conceivable magnitudes. But if I continue exhausting, the dark space E round the negative pole A becomes visible, grows larger and larger, and at last fills up the entire tube. The molecules at this stage are in a condition different from those in a less highly exhausted tube. At low exhaustions they behave as gas in the ordinary sense of the term, but at these high exhaustions, under electric stress, they have become exalted to an *ultra-gaseous* state, in which very decided properties, hitherto masked, come into play.

The radius of the dark space varies with the degree of exhaustion, with the kind of gas in which it has been produced, with the temperature of the negative pole, and to a less extent with the intensity of the spark.

It has been erroneously assumed that I ever said the thickness of the dark space represents the mean free path of the molecules in their ordinary condition, and it has been pointed out that the radius of the dark space is decidedly greater than the calculated mean free path of the molecules. I have taken accurate measurements of the radius of the dark space at different pressures, and compared it with the calculated mean free path of the gaseous molecules at corresponding pressures when not under the influence of electrical energy, and I find that they do not bear a constant relation one to the other. The length of the dark space is not twenty times the mean free path, as

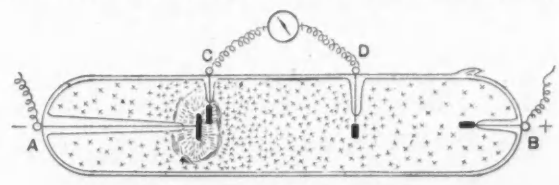


FIG. 8 B.—P = 0.25 MM. = 330 M.

some have estimated, but a gradually increasing multiple must be taken as the exhaustion becomes greater.

EXPLORATION WITH IDLE POLES.

Wishing to learn something of the electrical condition of the matter within and without the dark space, I made a tube (Fig. 7), having besides the positive and negative terminals A B two extra intermediate poles C and D; the tube showed that when the exhaustion was such that both the idle poles were outside the dark space, on passing the current through the tube there was a considerable difference of potential between them when measured on the galvanometer. If the exhaustion was carried so high that one of the extra poles was just on the border of the dark space, then no current passed between them. When the exhaustion was still further increased so as to enclose one of the extra poles fully in the dark space, again there was a great difference of potential between them, but the direction was reversed, the pole at highest potential now being the one formerly at lowest potential.

When the dark space had been further explored by means of a movable negative pole, I found that the effects did not depend essentially on the exhaustion, and were really due to the position occupied by the extra poles with regard to the dark space.

These phenomena are difficult to understand from mere description, and the experiments themselves are not easy to carry out so as to be visible to many at a time. I have here, however, a working model of an apparatus which will make these puzzling indications clear to all.

*"Experimental Researches in Electricity," 1838, par. 1,544.

A cylindrical tube (Fig. 8, a, b, and c, $P = 0.25$ millimetre), furnished with the usual poles A B at the ends, has two extra or idle poles near together at C and D. The pole A is movable along the axis of the tube, so that when exhausted the dark space can be brought to any desired position with respect to the idle poles C and D. The shading and + and — marks roughly show the distribution of positive and negative electricity inside the tube. I start with the negative pole A as far as possible from either idle pole (Fig. 8, a). Turning on the coil you see the dark space surrounding the pole A, and the idle poles quite outside.

The shading shows that each idle pole is in the positive area, and on testing with a gold leaf electroscope it will be seen that each is charged with positive electricity. But the shading also shows more positive at C than at D, and on connecting C and D with a galvanometer the needle in-

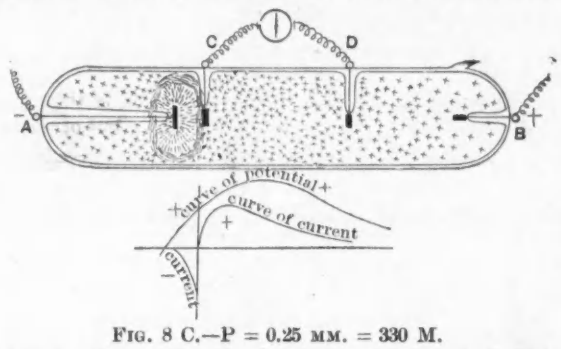


FIG. 8 C.—P = 0.25 MM. = 330 M.

dicates a rush of current from C to D, D being negative to C

The dark space is next brought to such a position that the pole C is well within it (Fig. 8, b). A change has now come over the indications. The galvanometer shows a reverse current to that which was seen on the former occasion. C is now negative and D positive, but the gold leaves still tell us both poles are positively electrified.

At a certain position of the dark space, when its edge is on the pole C (Fig. 8, c), a neutral state is found at which the gold leaves still show strongly positive electrifications, and no current is seen on the galvanometer. The curves below (Fig. 8, c) roughly show the rise and fall of negative and positive current at different parts of the tube, while the potential curve keeps positive.

When a substance that will phosphoresce under electrical excitement is introduced into the tube, the position of greatest luminosity is found to be at the border of the dark space, just where the two opposing armies of negative and positive atoms meet in battle array and re-combine. Later on I shall refer to this phenomenon in connection with the phosphorescence of yttria.

RADIANT MATTER.

By means of this tube, Fig. 9, I am able to show that a stream of ultra-gaseous particles, or radiant matter, does not carry a current of electricity, but consists of a succession of negatively electrified molecules whose electrostatic repulsion overbalances their electromagnetic attraction, probably because their speed along the tube is less than the velocity of light. The tube has two negative terminals, A, A', close together at one end, enabling me to send along the tube two parallel streams of radiant matter, rendered visible by impinging them through holes in a mica diaphragm on a screen of phosphorescent substance. It is exhausted to a pressure of 0.1 millimetre. I connect one of the negative poles, A, with the induction coil and the luminous steam darts along the tube from C to D parallel with the axis. I now connect the other negative pole,

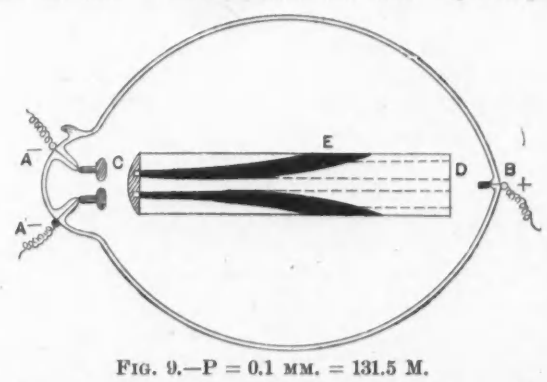


FIG. 9.—P = 0.1 MM. = 131.5 M.

giving a second parallel stream of radiant matter. If these streams are in the nature of wires carrying a current they will attract each other, but if they are simply two streams of electrified molecules they will repel each other. As soon as the second stream is started you see the first stream jump away in the direction C E, showing strong repulsion, proving that they do not act like current carriers, but merely like similarly electrified bodies. It is, however, probable that were the velocity of the streams of molecules greater than that of light, they would behave differently, and attract each other, like conductors carrying a current.

To ascertain the electrical state of the residual molecules in a highly exhausted tube, such as you have just seen, I introduced an idle pole or exploring electrode between the positive and negative electrodes in such a manner that the molecular stream might play upon it. The intention was to ascertain whether the molecules on collision with an obstacle gave off any of their electrical charge. In this experiment, Fig. 10, $P = 0.0001$ millimetres, or 0.13 metres,* it was found that an idle pole, C, placed in the direct line

* M. = one-millionth of an atmosphere.
1,000,000 M. = 760 millimetres.
" = one atmosphere.

between the positive and the negative poles, *A B*, receiving in consequence the full impact of the molecules shot from the negative pole, manifested a strong *positive* charge. In a variety of other experiments made to decide this question, the electricity obtained was always found positive on testing with the gold leaf or Lippman's electrometer, and when the idle pole was connected to earth through a galvanometer a current passed as if this pole were the copper element of a copper zinc cell, indicating leakage of a current to earth, the idle pole being positive. If, instead of sending this current to earth, the wire was connected to the negative pole of the tube, a much more powerful current passed in the same direction.

THE EDISON EFFECT.

An exactly parallel experiment has been made by Mr. Edison, Mr. Preece, F. R. S., and Professor Fleming, using instead of a vacuum tube, an incandescent lamp. They

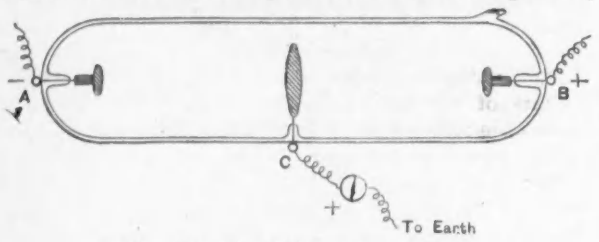


FIG. 10.—P = 0.0001 MM. = 0.13 M.

found that from an idle pole placed between the ends of the filament the electricity always flowed as if the pole were the zinc element of a copper-zinc cell; having repeated their experiments I entirely corroborate them. I get a powerful current in one direction from an idle pole placed between the limbs of an incandescent carbon filament, and one in the opposite direction from an idle pole in a highly exhausted vacuum tube. This discrepancy was extremely puzzling, and I tested with a similar result very many experimental tubes made in different ways. The electricity obtained from an idle pole placed between the positive and negative terminals in a highly exhausted tube was always strongly *positive*, and it is only recently that continued experiment has cleared the matter up.

Some of the contradictory results are due to the exhaustion not being identical in all cases. In my vacuum tubes the directions of current between the idle pole and the earth changes from negative to positive as the exhaustion rises higher. Testing the current when exhaustion is proceeding, there is a point reached when the galvanometer deflection—hitherto negative—becomes nil, showing that the potential at this point is zero. At this stage the passage of a few more drops of mercury down the pump tube renders the current positive. This change occurs at a pressure of about 2 millimetres.

After this point is reached, when the induction current is passed through the tube, the walls rapidly become positively electrified, probably by the friction of the molecular stream against the glass, and this electrification extends over the surface of any object placed inside the tube. I will show you how this electrification of the inner walls of the tube acts on the molecular stream at high vacua. In this tube, Fig. 11 ($P = 0.001$ millimetre or 1.3 M), are fixed two exactly similar phosphorescent screens *C* and *D;* at one end of each is a mica gate *E, E'*, with a negative pole *A, A'*, facing it. One of the screens, *C*, is in the cylindrical part of the tube and close to the walls; the other, *D*, is in the spherical portion, and therefore far removed from the walls. On passing the current the screen *D* in the globe shows a narrow sharp streak of phosphorescence, proving that here the molecules are free to follow their normal course straight from the negative pole. In the

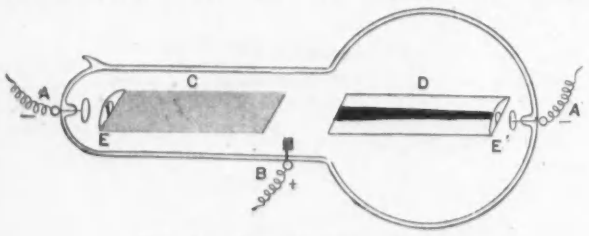


FIG. 11.—P = 0.001 MM. = 1.3 M.

cylindrical part of the tube, however, so great is the attraction of the walls that the molecular stream is widened out sufficiently to make the whole surface of the screen *C* glow with phosphorescent light.

(*To be continued.*)

The Photographic Action of Electromagnetic Waves.

In the *Wiener Berichte* of Oct. 9, 1890, Franz von Dobrzynski says: I have for several months been engaged in investigating the photographic action of electromagnetic waves. The electromagnetic waves were obtained by the method of Hertz. They acted on dry bromide of silver and gelatine "Nys" plates procured from Geissler in Bonn. The plane of the plates either included the axis of the vibrator, or was at right angles to it. The exposure was three hours. No sensitization of the plates was made. The development and fixation took place in the ordinary manner by ferric oxalate and hyposulphite. The action was visible after development and fixation by the appearance of alternating bright and dark bands across the direction of vibration of the waves, or by the appearance of dark bands in the direction of the vibration. Both kinds of bands could occasionally be observed together. In many experiments the plates were covered with tin foil. Portions of the coating of the tin foil were cut away. The tin foil did not prevent the formation of bands. This points to the fact that the chemical action which here comes into play is not a primary one. The cross bands suggested stationary vibrations. They might be due to reflection from the sides of the wooden box, by which the plates were protected from the influence of extraneous rays; but they might also owe their origin to reflection from the side of the room. The only experiment which could be made with a reflecting metal ball was not in disagreement with this view; the cross bands were now more distinct and regular. If this view is correct, it may be concluded that waves from 0.6 to 20 centimetres are effective.

The Construction and Use of Electrical Testing Apparatus.

BY CHARLES P. FREY, CHIEF ELECTRICIAN OF THE GREELEY ELECTRICAL LABORATORY.

VIII.

Shunt Boxes for Galvanometers.—These are small circular or flat resistance boxes provided with plugs, binding posts, etc., and containing coils, the resistance of which are respectively $\frac{1}{9}$, $\frac{1}{99}$ and $\frac{1}{999}$ of the resistance of the galvanometer for which they are intended. The round shunt box (Fig. 33) is generally preferred for galvanometers of tripod pattern, while the oblong box (Fig. 34) is convenient for square pattern galvanometers owing to its low binding posts. The binding posts of the shunt box are respectively connected with the binding posts of the galvanometer, so that any current passing through conductors to the galvanometer is partially diverted through the shunt coils and the resistance of the galvanometer and shunt combined thereby reduced to the $\frac{1}{10}$, $\frac{1}{100}$ or $\frac{1}{1000}$ part of the galvanometer resistance alone. The explanation of this is that the re-

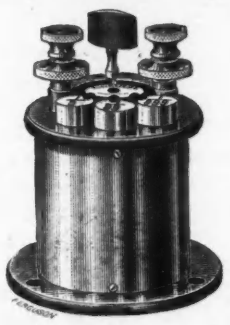


FIG. 33.—ROUND SHUNT BOX FOR GALVANOMETER.

sistance of a divided circuit is equal to the product of the two resistances divided by their sum.

If for instance we send a current through two resistance coils connected in multiple arc, and their respective resistances are 6 ohms and 30 ohms, their joint resistance will be

$$\frac{6 \times 30}{6 + 30} = 5.$$

In the same manner, if the resistance of a galvanometer is for instance 5,494.5 ohms, and the shunt coils being $\frac{1}{9} = 610.5$, $\frac{1}{99} = 55.5$, and $\frac{1}{999} = 5.5$, it follows by this formula, if the $\frac{1}{9}$ shunt is used, that the equation takes this form: $\frac{5{,}494.5 \times 610.5}{5{,}494.5 + 610.5} = 549.45$, which $\frac{1}{10}$ the original or galvanometer resistance.

Or, if it is desirable to reduce the resistance of the galvanometer to its $\frac{1}{100}$ part, the $\frac{1}{99}$ shunt coil when used will accomplish this result, for $\frac{5{,}494.5 \times 55.5}{5{,}494.5 + 55.5} = 54.945$, which is $\frac{1}{100}$ the original resistance. In the same manner the resistance can be reduced to its $\frac{1}{1000}$ by using the $\frac{1}{999}$ shunt coil.

If galvanometer and shunt have each the same resistance, it is evident that the current will be halved. If the resistance of the galvanometer is greater than the shunt's the latter will convey the larger portion of the current. Now since increasing the amount of current flowing through the galvanometer coils will accelerate their influence on the needles or system, it follows that the "sensitiveness" (responsive action) of the galvanometer can be increased or diminished proportionately with the augmentation or diminution of the resistance of the shunt coils. This is practically the case, but owing to the reduction in resistance of the entire circuit by the introduction of a shunt coil, the strength of the current from the battery is somewhat increased; and if, for instance, galvanometer and shunt should have the same resistance, it is said that somewhat more than half of the original current would flow through galvanometer and shunt respectively.

Since diverting part of the current by means of a shunt reduced the sensitiveness of the galvanometer, it follows that when galvanometer and shunt are connected together in multiple in the first place the sensitiveness of the galvanometer can be increased by increasing the resistance of the shunt, and if desirable finally dispensing with the latter. This operation is so self-evident that it is mentioned only because it is frequently referred to technically as the "multiplying power of a shunt."

Shunt coils should be constructed of insulated copper wire, in order that their temperature coefficient will be as nearly as possible identical with that of the wire on the coils of the galvanometer. It must be remembered that when shunt coils are purchased with a galvanometer, their resistance, unless otherwise ordered, will be respectively $\frac{1}{9}$, $\frac{1}{99}$ and $\frac{1}{999}$ the *maximum* resistance of the galvanometer, that is, with its coils connected in series.

Constant of a Galvanometer.—To test insulated conductors for leakage or impairment of insulating materials, a set of apparatus is employed which consists usually of a 100 cell chloride of silver battery, a reflecting galvanometer with shunts and scale, a $\frac{1}{10}$ megohm box, and a contact key of the reversing type (Fig. 35) or a commutator.

A necessary preliminary operation to tests of this kind is the determination of the "constant" of the galvanometer.

The constant of a reflecting galvanometer is the theoretical resistance which would limit the deflection of the spot of light on the scale to one scale division with (usually) 100

FIG. 34.—OBLONG SHUNT BOX FOR GALVANOMETER.

cells in circuit and with galvanometer connected without shunt.

These data are secured by connecting the galvanometer with the 100 cells through the $\frac{1}{10}$ megohm and key. The shunt is connected across the galvanometer terminals with a plug in the $\frac{1}{999}$ hole. (Hence the galvanometric sensitiveness can later be increased 1,000 times.) The scale should be placed accurately at right angles to the line of light when at the zero mark. The key is then depressed and kept closed until the deflection is fixed. If the spot of light disappears from the scale and fails to return, the battery power must be reduced. Now if with 100 cells in circuit, the spot of light should remain deflected 340 scale divisions, the constant is calculated as follows:

$$340 \times 1{,}000 \times 100{,}000 = 34{,}000{,}000{,}000 \text{ (constant)},$$

or pointing off six places, constant is 34,000 megohms. For: $340 \times 1{,}000$ would be the theoretical deflection through $\frac{1}{10}$ megohm without shunt, and $340{,}000 \times 100{,}000$ ($\frac{1}{10}$ megohm) would be the theoretical deflection without either shunt or resistance. The calculation can of course be simplified by reducing the first product to megohms by dividing by 10; $\frac{340{,}000}{10} = 34{,}000$, or avoiding all calculation by employing a megohm box instead of a $\frac{1}{10}$ megohm. Having secured these data, the resistance to be measured is inserted in place of the $\frac{1}{10}$ megohm, and a coil in the shunt box selected which will permit a deflection nearest 350. If the deflection thus obtained be for instance 250 scale divisions, and the shunt coil used the $\frac{1}{9}$, then the theoretical deflection without shunt would be 250×10 equaling 2,500, and dividing the constant by this: $\frac{34{,}000{,}000{,}000}{2{,}500}$ we get 13,600,000 ohms, or 13.6 megohms, which is the value of the resistance.

It must be remembered that increasing the distance between galvanometer and scale will add to the numerical value of the constant, hence it is absolutely necessary that the galvanometer and scale remain fixed after the constant has been determined, until all tests are completed. It is

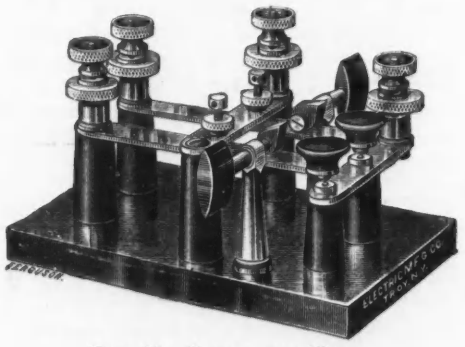


FIG. 35.—REVERSING KEY.

almost impossible to secure results approaching accuracy if the galvanometer is transferred to a new place and testing proceeded with without redetermining the constants.

By noting remarks in a preceding article, concerning the adjustment of the directing magnet on a reflecting galvanometer, it will be clear that the position of the directing magnet will affect the value of the constant enormously. It must, therefore, be left undisturbed after being adjusted to a position which will permit the greatest possible sensitiveness under perhaps unfavorable conditions, and at the same time regulated in such a manner that the spot of light will always return exactly to zero.

The sensitiveness of a galvanometer is sometimes questioned, because an instrument of different design is said to give a "greater constant." Now the only fair basis for comparison in such cases is to test these rival instruments under precisely like conditions. The subdivisions on the scales must be the same, also the distance between scale and galvanometer, and necessarily equal battery power and resistance should be employed. In fact, the fairest plan would be to interchange the galvanometers, or treat them both successively with the same apparatus.

Electrical Equipment of Our "Squadron of Evolution."*

BY LIEUT. HAMILTON HUTCHINS, U. S. N.

EQUIPMENT OF THE "CHICAGO" (CONTINUED).

Range Finder.—This instrument has already been described in THE ELECTRICAL WORLD. The apparatus has just been installed on board the "Chicago," and at this date there have not been a sufficient number of practical tests to form an opinion as to the limits of its probable accuracy on board ship when used by careful hands. This ingenious instrument is the invention of Lieut. Fiske. A Wheatstone bridge constitutes the electrical part of the apparatus, the mechanical part consisting of a telescope at each end of the base line, the base line being either the length or the beam of the ship, according to circumstances. Three observers are required, one at each telescope and one at the galvanometer.

In connection with the range finder the usefulness of another instrument proposed by the writer would seem apparent. For instance, with our new cruisers it is a weak point with them that the means of communication from the upper deck to the officers in charge of gun divisions is not at all what it should be.

In time of action we will suppose that the range finder, which is mounted on the upper deck, has determined the range. What now becomes of most importance is to transmit the value of this distance to the officers commanding gun divisions on the covered gun decks. The arrangement can be, for any particular division, as follows (Fig 10):

A Wheatstone bridge is placed in the conning tower or other desirable point, the two galvanometer leads being run to a place in rear of or over the gun. The galvanometer or indicator would have a pointer moving over a scale on which would be marked the range in yards. The bridge would be in a slide wire form with a scale of ranges attached. The value of the marks on the scale as also those on the indicator scale would be previously ascertained from experiment; in other words, the apparatus would be calibrated. Then as the range finder showed a change in the range, the sliding contact would be moved its proper amount, so as to vary the ratio of the arms of the bridge, and the indicator at the gun would show the corresponding change in the range. Two or more of these instruments could be worked at the same time, corresponding to the number of gun divisions. In fact, it would practically be desirable to communicate the range to all the gun divisions at once. Thus the indicators at the guns would be always in circuit and always indicating the range. The apparatus would require a constant potential, which can be obtained from the storage battery that supplies the range finder.

Night Signals.—The time has arrived for the navy to adopt a system of signaling rapidly at night. Several different arrangements of incandescent lamps have been proposed, and it can be assumed that this squadron will test and recommend a good system of night signaling with incandescent lamps. For the Morse code at night, either incandescent lamps or the search lights can be used, depending on the distance.

Bell Circuits.—The cabin and other officers' quarters have the usual communications to different parts of the ship. These need no description. It is intended also to introduce a fire alarm circuit into different parts of the ship, as by this means, with the peculiar construction of the new cruisers, the ship's company can detect the signal more readily than by the usual methods. Coal bunker and water alarms are also provided.

Motors.—On one of the four eight-inch gun carriages two motors are attached, one for training and one for elevating. Either the motors or the hand training and elevating gear can be used as desired by throwing the clutch out of gear. The training motor is five horse power, the maximum current being about 40 ampères with a heavy load. The connections are as shown in the figure, the voltage being 106, as already stated in the description of the lighting plant. (See Fig. 12.

The elevating motor is one-half horse power at 106 volts, with connections as in the figure. In both motors it will be observed that the direction of rotation is reversed by reversing the direction of the current in the armature only. The training motor is series wound, as the nature of the work is such that the load and speed vary widely. On starting, for instance, the load is heavy and the speed low, but there is always some load on the motor.

The elevating motor is shunt wound. With this motor the speed varies with a variation in the load, but only through a small range, say five to ten per cent. Absolute constancy of speed is not required in work of this nature.

Torpedoes.—Electricity is also the agent for exploding the torpedoes with which the vessels of the squadron are supplied. Until recently both ships and the ships' launches of the navy have been fitted for exploding spar torpedoes, but now the spar torpedoes fired from ships have been abolished, so that the vessels are supplied with boat outfits only. The charge of the service torpedo (including the three-pound primer charge of dry gun cotton) is equivalent to 35 pounds of dry gun cotton. The detonator contains 35 grains of fulminate of mercury, which is used to detonate the primer charge of dry gun cotton, and this in turn detonates the torpedo charge of wet gun cotton. Either a small Farmer's dynamo (series wound) or a battery of four open circuit cells, is used to supply the current. A complete metallic circuit is used between the battery and the torpedo, no ground return being allowed.

The fuse bridge has a hot resistance of .65 ohm and the current necessary to fire instantly is .6 ampère. When the fuse bridge reddens on firing, the mealed gun cotton which surrounds it is ignited and then the fulminate of mercury. Fig. 8 shows the detonator. Fig. 7 shows the torpedo. As ordinarily used, this torpedo, known as the service torpedo, can only be fired at will. To convert the service torpedo into a contact torpedo, take the circuit closer (Pattern *B*, shown in Fig. 9) and attach it to the lower head of the torpedo by screws through feet. The contact torpedo can be fired either by contact (on striking the target) or at will, as desired. Three leading wire used with the contact torpedo, as shown in Fig. 9, painted respectively *black*, *white*, and *red*.

It will be noticed that the gun cotton discs, as represented in Fig. 7, are of the square form, which is the latest form adopted for the navy, for in this way a greater weight of gun cotton can be stored in a given space. The vessels are supplied with the round discs at present, but this will be the case only until the stock on hand is exhausted.

No automatic torpedoes have yet been supplied to these or any other vessels in our navy; when they are, electricity will undoubtedly be used to launch them.

Submarine mines have not yet been supplied to the ships, but they are a necessary part of the equipment of every modern man of war.

II. EQUIPMENT OF THE "ATLANTA."

The search light plant is similar to that of the "Chicago," already described.

The incandescent plant consists of one 150-light shunt-wound Weston dynamo, designed for an armature speed of 1,250 revolutions per minute, and belted to an Armington & Sims engine making about 300 revolutions per minute. The floor space required for engine and dynamo is 17 feet 5 inches × 6 feet; weight, 6,500 pounds. A detailed de-

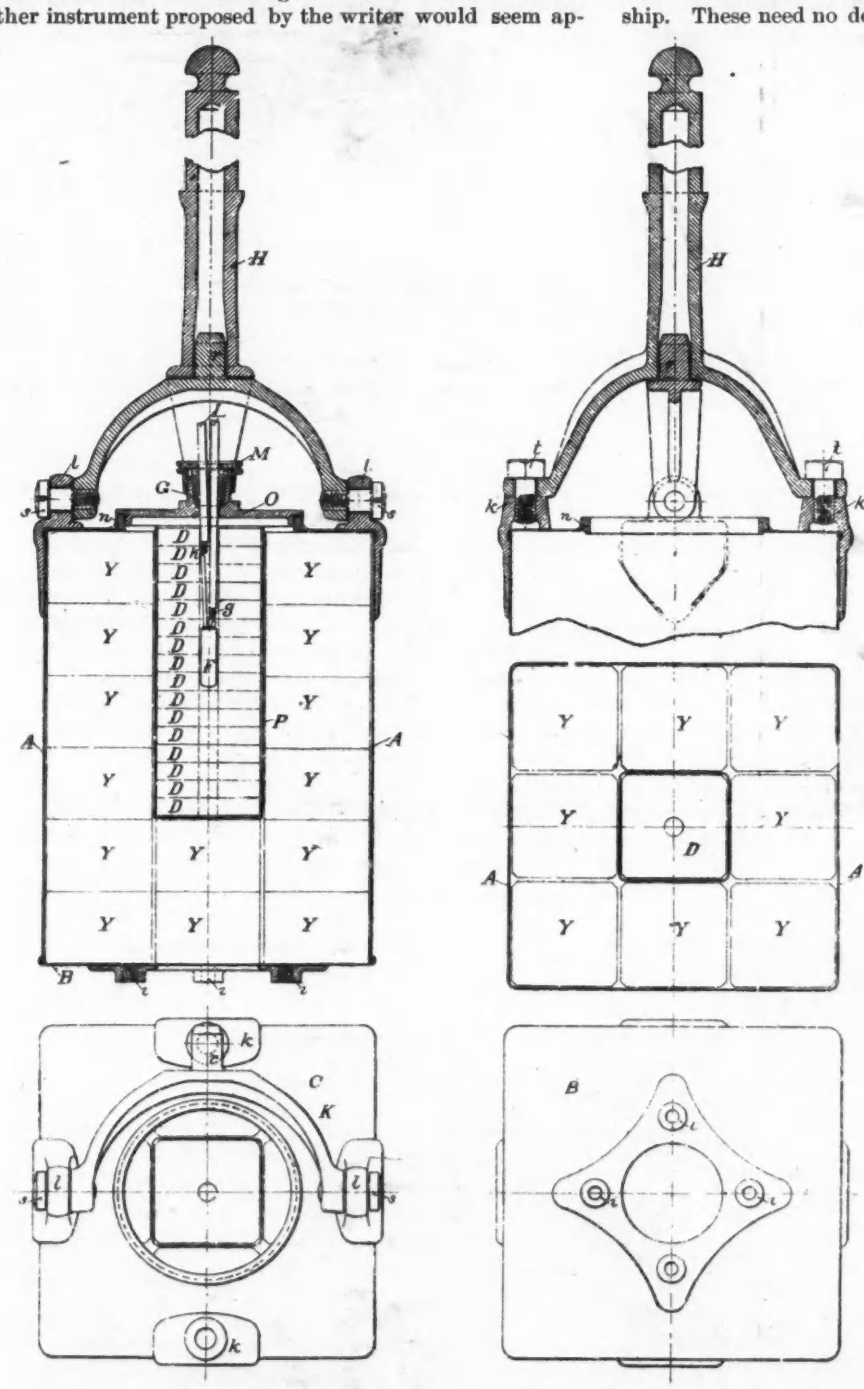


FIG. 7.—SERVICE TORPEDO, PATTERN D.

A barrel; *B* lower head; *C* upper head; *x* screw-tap; *g*, *h* splices between leading wires and detonator wires; *K* handle; *l* lugs for handle; *k* lugs for spindle; *i*, *i* screw holes for attaching circuit closer; *n* screw rib for primer case cover; *r* projection on handle shipping into spindle; *s* screws securing handle to case; *t* screw bolts securing spindle to case; *H* spindle; *L* spar leading wires; *M* water caps; *P* primer case; *O* primer case cover; *G* rubber gland; *D D D D* dry gun cotton primer; *F* detonator; *V* wet charge.

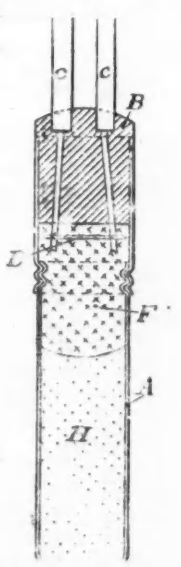


FIG. 8.—IGNITER.

A metal case; *B* plug; *c c* wires; *D* bridge; *F* gun-cotton priming; *H* fulminate of mercury.

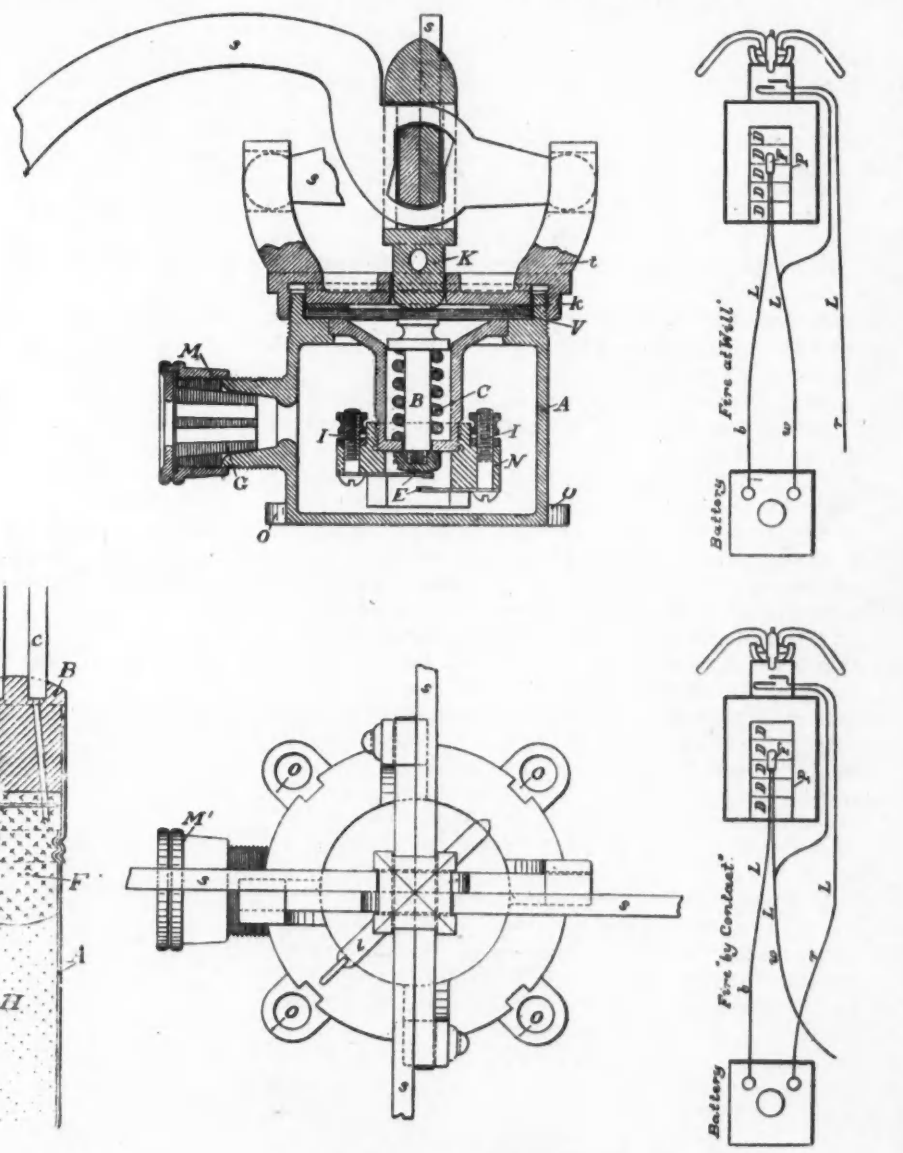


FIG. 9.—CIRCUIT CLOSER, PATTERN B.

A hollow composition casting; *M M'* water cap; *G G'* rubber gland; *O O* feet or lugs for attaching circuit closer to service torpedoes, Patterns C and D; *B* inner brass plunger; *C* spiral spring; *N* ebonite collar; *I* binding post; *E* contact spring; *t* brass cap; *s s* contact arms; *K* outer plunger; *l* safety pin; *V* rubber diaphragm; *k* friction plate; *r* red leading wire; *w* white leading wire; *b* black leading wire; *F* detonator; *P* primer case; *L* spar leading wires; *D D D D* dry gun cotton primer.

* Concluded from THE ELECTRICAL WORLD, Jan. 31, 1891.

scription of this plant is given in General Information Series, No. VI., of the Office of Naval Intelligence. The dynamo is well constructed (Weston), and, although dynamos running with a belt are liable to be a source of trouble on shipboard, the plant has been in operation over three years, and has given little or no trouble. The lamps are Weston, 110 volts. The diving lamp is supplied to this as well as the other vessels of the squadron.

The only other application of electricity that exists on board the "Atlanta" is a Sprague motor for hoisting ammunition.

Ammunition Hoist.—This is a 3 h. p. differential motor for constant speed work. The connections are as shown in Fig. 13, which shows the arrangement for reversing the direction of rotation of the motor by reversing the current in the armature, and also the resistances in the series field used to keep constant speed with variable load. Some interesting remarks on this shell hoist, including the magnetic brake attachment, can be found in No. 50 of the Proceedings of the U. S. Naval Institute, in an article by Mr. S. D. Greene.

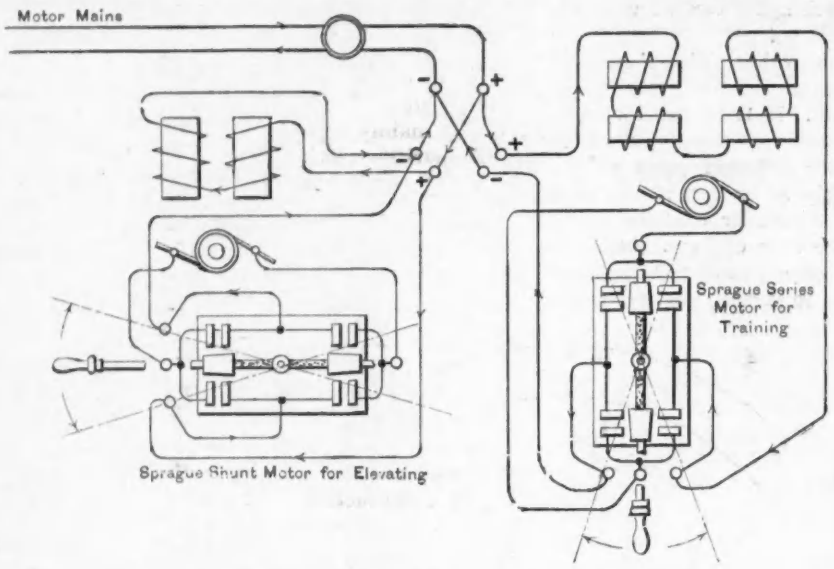


FIG. 12.—CONNECTIONS OF THE "CHICAGO'S" GUN TRAINING MOTOR.

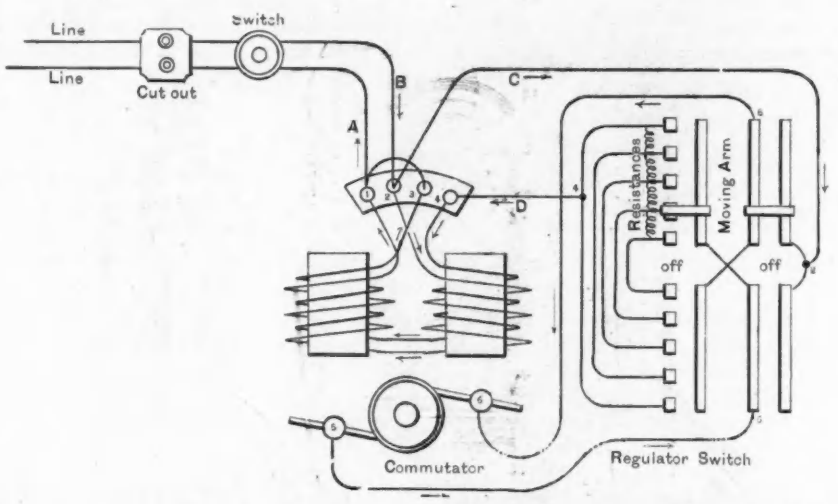


FIG. 13.—CONNECTIONS OF THE "ATLANTA'S" SHELL HOISTING MOTOR.

III. EQUIPMENT OF THE "BOSTON."

The search light plant is similar to that of the "Atlanta" and "Chicago." For the ship lighting there is a single plant only. The dynamo is, and always has been, the ordinary typical Brush dynamo, but compound wound. No dynamo is suitable for incandescent lighting which cannot run without sparking, and this applies to all the Brush dynamos that have been supplied to this ship, the present one being the fourth. Portions of the commutator segments have to be continually renewed. Formerly a Straight Line engine was used, running with a belt to the dynamo, but at present the engine is an Armington & Sims, of the double horizontal type, the mode of connection between the engine and dynamo being rawhide gearing. One bad feature is the noise made by this gearing, so that any unusual sound about the engine, whereby a practical engine driver can determine at once if anything is wrong, cannot in this plant be detected. Aside from that, however, with most types of dynamos this mode of connection between the engine and dynamo might answer, but with the peculiar magnetic circuit of the Brush dynamo, as soon as the bearings become worn the motion of the armature is at once assisted by the attraction due to one or the other of the pole pieces, and the trouble is increased. With this type of dynamo the only remedy would be a direct connection to the engine. It would be economy to supply the ship with a modern plant.

It is believed that the wiring is very good considering the time at which the plant was installed. The lamps (Swan) are satisfactory and the electrical arrangements in the officers' quarters are better even than in some more recent plants. The output of the dynamo is 98 ampères with 92 volts at the terminals. The speed of the engine is 450 revolutions and the dynamo 1,200.

IV. EQUIPMENT OF THE "YORKTOWN."

The plant, used both for ship lighting and for operating the search lights, consists of two engines and dynamos, duplicates of each other. Each engine is an Armington & Sims double horizontal, and directly connected to the dynamo, both dynamo and engine running at a speed of 460 revolutions. The dynamos are of a recent Edison type, being compound wound for 80 volts at the terminals at the above speed. A general description of the dynamo and the plate are taken from General Information Series, No. VIII., of the Office of Naval Intelligence. All of the iron parts of the magnetic circuit are wrought, with the exception of the cast-iron keeper, which also serves to support the magnets. There are eight poles, the four outside ones being north, the four inside the armature being south and 45 degrees distant from the former. With this construction an overhanging armature becomes a necessity, but it is well balanced and secured to the shaft by means of an eight-armed bronze spider. The armature core is built up of thin sheet-iron laminated rings, insulated with prepared paper. The end rings, however, are solid brass and through-bolted to the spider, whose alternate arms are insulated from the armature core, in order to prevent the currents which would be set up in the arms, owing to the fact that they are cutting fields in opposite directions. As with many other multipolar machines, the points of equal potential on the armature are connected together so as to necessitate but one pair of brushes. The dynamo and engine are represented in Fig. 11.

A more modern and ideal naval plant, consisting of a multipolar compound dynamo, but directly connected to a vertical engine, was constructed at the direction of the Bureau of Ordnance, and intended for the search light plant of this ship. The engine was built by the Armington & Sims Company, and the dynamo by the Thomson-Houston Electric Company, being similar in principle and electrical dimensions to those of the "Chicago," "Boston" and "Atlanta."

Search lights and ship lighting constitute the only application of electricity on board the "Yorktown."

This completes the outfit of the squadron up to the present time. The amount of applied electricity on board the "Chicago," it will be noticed, by far exceeds that of the other vessels. Although the development and use of electricity on board ship is not the subject of this paper, the writer cannot refrain from making one or two remarks. For instance, take a ship like the "Chicago," with her large electrical equipment. Although certain portions of it are, of course, purely experimental, it is safe to say that with future cruisers the amount of electrical power required for them will be considerably greater than it is to-day. The development, of course, will be principally in the direction of electric motors. With the large cruisers, then, the necessity exists for supplying them with a satisfactory measuring apparatus. The only galvanometer, for instance, that is suitable for electrical measurements with any degree of accuracy on board ship is the Thomson marine galvanometer, which can be used either at sea or in port.

It will be only a question of a few years when the cruisers having large electrical equipments will be fitted up with a small test room, which will include a Thompson marine galvanometer. In fact the writer officially recommended this nearly two years ago. The apparatus would consist principally of a few resistance boxes, a standard Clark cell, a standard condenser and a Thomson marine galvanometer; and it is astonishing the variety of electrical measurements that can be made with the above means, as for instance — the copper or insulation resistance of any wire or cable about the ship or its capacity can be measured, voltmeters can be standardized, the E. M. F. and resistance of batteries measured, etc.

Another point that is certain to come up is the subject of the effect on the compasses of the dynamos.

There are two ways in which the magnets of the compasses may be effected—that is by the field produced by one of the outside circuits of the dynamos, or directly from the magnetic leakage of the dynamos. There may be times when all the search lights, motors and a portion of the incandescent lamps will be in use, and in this case nobody can say that the compass will not be effected no matter where it is placed, due to the magnetization of the soft iron bulkheads, etc. This effect on the compasses can be neutralized by creating lines of force in the opposite direc

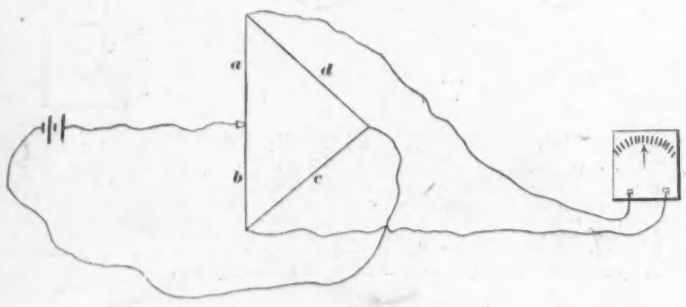


FIG. 10.

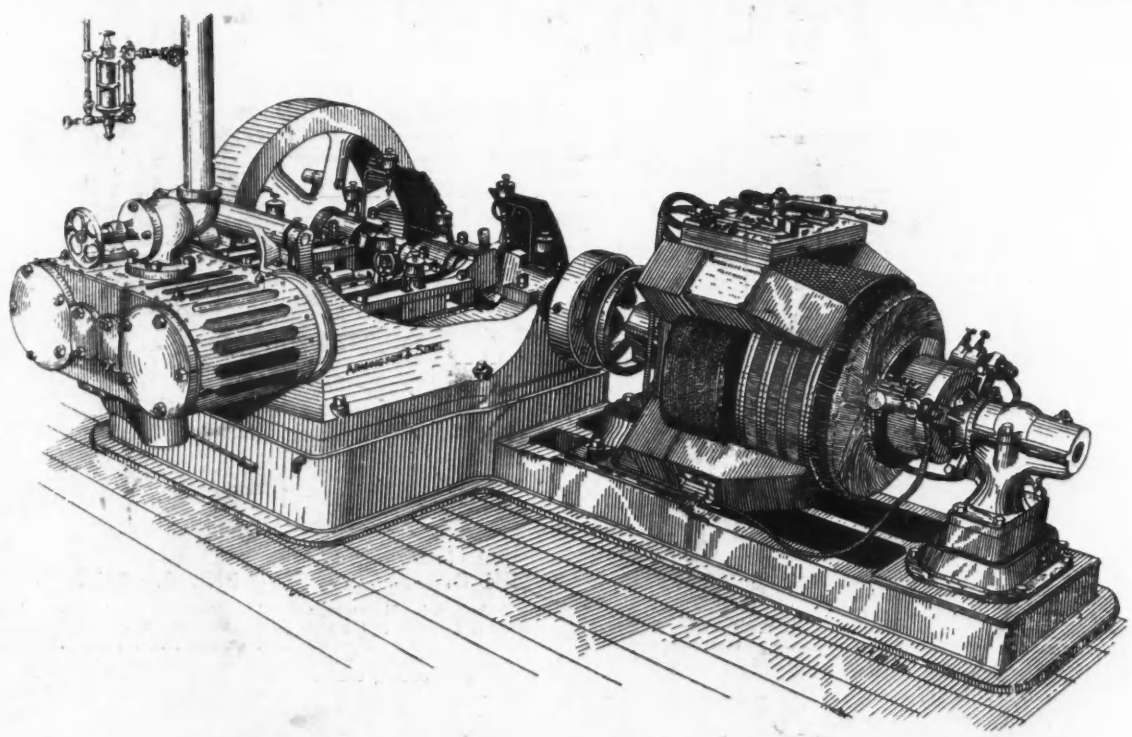
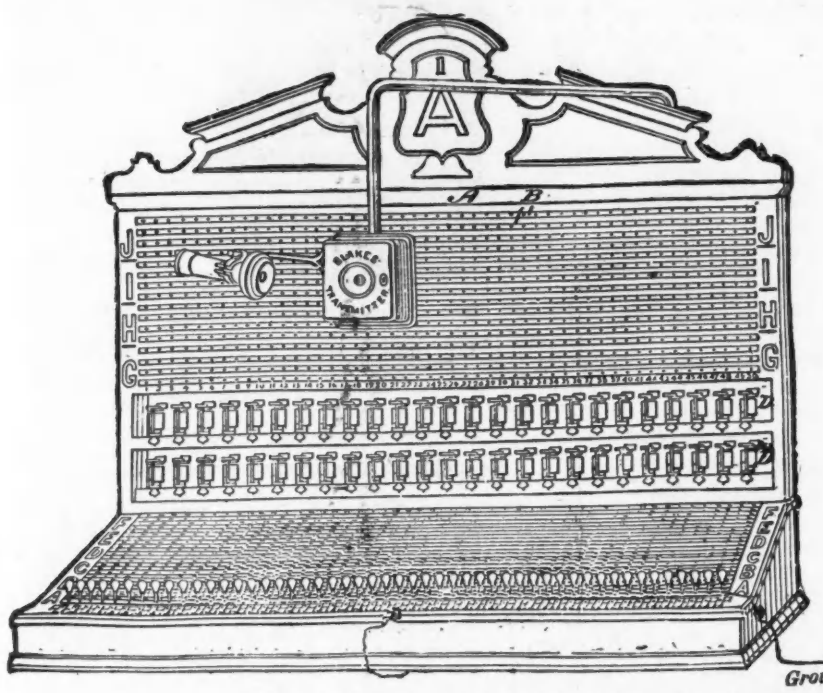


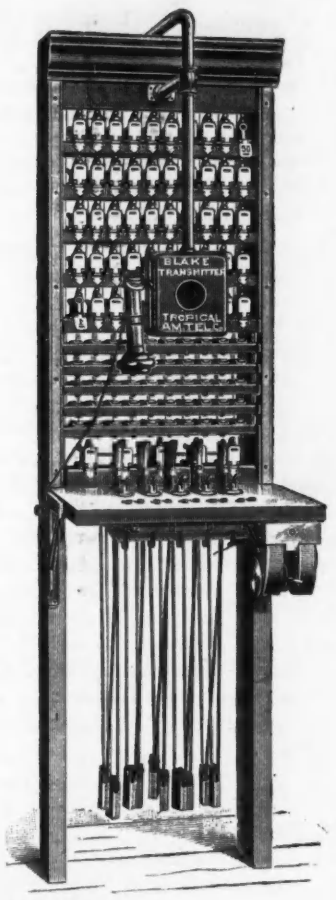
FIG. 11.—MARINE DYNAMO AND ENGINE OF U. S. S. "YORKTOWN."

tion, but this is a useless expenditure of energy, and should be avoided if possible. A deviation of the compass of only one or two degrees, due to the dynamos, is of considerable importance with vessels of high speed, and this amount of deviation is not infrequent. It is evident that the proper solution of the problem lies in the "iron-clad" type of dynamo, such as the Wenstrom or Eickemeyer, where magnetic leakage is reduced to a minimum, and this will no doubt be the general type of the marine dynamo of the future, if their weight can be reduced. The effect on the compass due to the field created by one of the outside circuits can be prevented by well known means.

Telephone Switchboards.

Two new switchboards of the Tropical American Telephone Company are shown in the accompanying illustrations. Fig. 2 shows what is known as the Williams





FIGS. 1 AND 2.—THE WILLIAMS TELEPHONE SWITCHBOARDS.

"Standard" switchboard. This is a cord board, with annunciator drops and automatic switches and keys for calling and connecting the telephone to subscribers' circuits. In this board the movements necessary to connect and disconnect subscribers are reduced to a minimum, and it is claimed to be the simplest and most expeditious in manipulation of any board yet devised. It is said to be in practical operation in about half the exchanges in the United States. It is the standard board adopted in Europe as well as in America for small exchanges.

By the use of superior stock in the construction of the frames and cords, and with weights to take up the slack of the cords, a simple but perfectly reliable and durable board is produced. The drops used are the Hynes or Williams drops. The complete boards for 50 lines are 16½ inches wide and 18 inches deep, and rise 62 inches from the floor.

Fig. 1 shows the Williams switchboard for 50 subscribers. This is a peg board, and is arranged for table operators. It has met with great favor and has had a very extensive sale in the United States. Recent improvements have been made in the details, including the drops and the cabinet work. The boards are lettered and numbered 1A, 2B, 3C, etc., and can be placed side by side, connecting each table with the next. The drops used are the same as those mentioned above. These boards are 5 feet 1 inch high on their stands, 3 feet 1 inch wide, and 2 feet 3 inches deep from front to rear.

The Duration of Telegraphic Currents.

In a recent issue the *Zeitschrift für Elektrotechnik* remarks that a few figures with regard to the duration of currents used in telegraphy may be of interest. In ordinary Morse working the average duration of the signaling current may be taken at .125 second; with the Hughes apparatus currents lasting only from .04 to .05 second are emitted, while with the Meyer multiplex apparatus currents having a duration of as little as .007 second, and with the Delany multiplex of .002 second are sent to line. The lowest figure is, however, reached by the Wheatstone automatic, which, when transmitting at the rate of 600 words a minute, sends out 33,600 currents per minute, or 560 per second, each having, therefore, a duration of .0018 second.

The Difference of Potential between Two Dilute Solutions of Binary Electrolytes.

The development of electricity and heat in electrolytes has been the subject of much investigation during the past few months by M. Planek, who has contributed several papers to Gilbert's *Annalen der Physik und Chemie*. In one of these papers (*vide* Series [2], Vol. XXXIX., p. 161) he argued that, since the ions of an electrolyte are endowed with large electrostatic charges, it follows that before the electromotive forces become active a certain finite determinable amount of free electricity must be formed in the solution. The forces necessary to cause a movement of electricity in an electrolyte are referred to in this paper, starting with the assumption that in an electrolyte the ions are present in a fully dissociated condition.

According to the London *Electrical Review*. Planek now considers (*vide Annalen Phys. Chem.*, Series [2], Vol. XL., p. 561) the integration of the differential equations for the general case of two solutions containing different electrolytes, having already calculated the difference of potential for the case of two solutions containing the same electrolyte in different proportions.

The existence between the two solutions of a limiting ayer of small but still finite thickness is assumed. Different values for the difference of potential are found according to the way in which the concentration is supposed to alter within the intermediate layer. Planek shows, however, that in a very short time a state of stability will be reached in which the total concentration sum (of the concentrations of the positive or negative ions) will vary within the layer as a linear function of the distance. This consideration is sufficient to make the above problem uniquely soluble, supposing the electrolytes to be completely dissociated. Planek compares the calculated values for the difference of potential with Nernot's experimental numbers, with which they show a satisfactory agreement.

An Improved Process for the Production of Copper.*

Mr. Percy C. Gilchrist has recently communicated to the London section of the Society of Chemical Industry the results he has obtained by applying what is known as the "basic process" to copper refining.

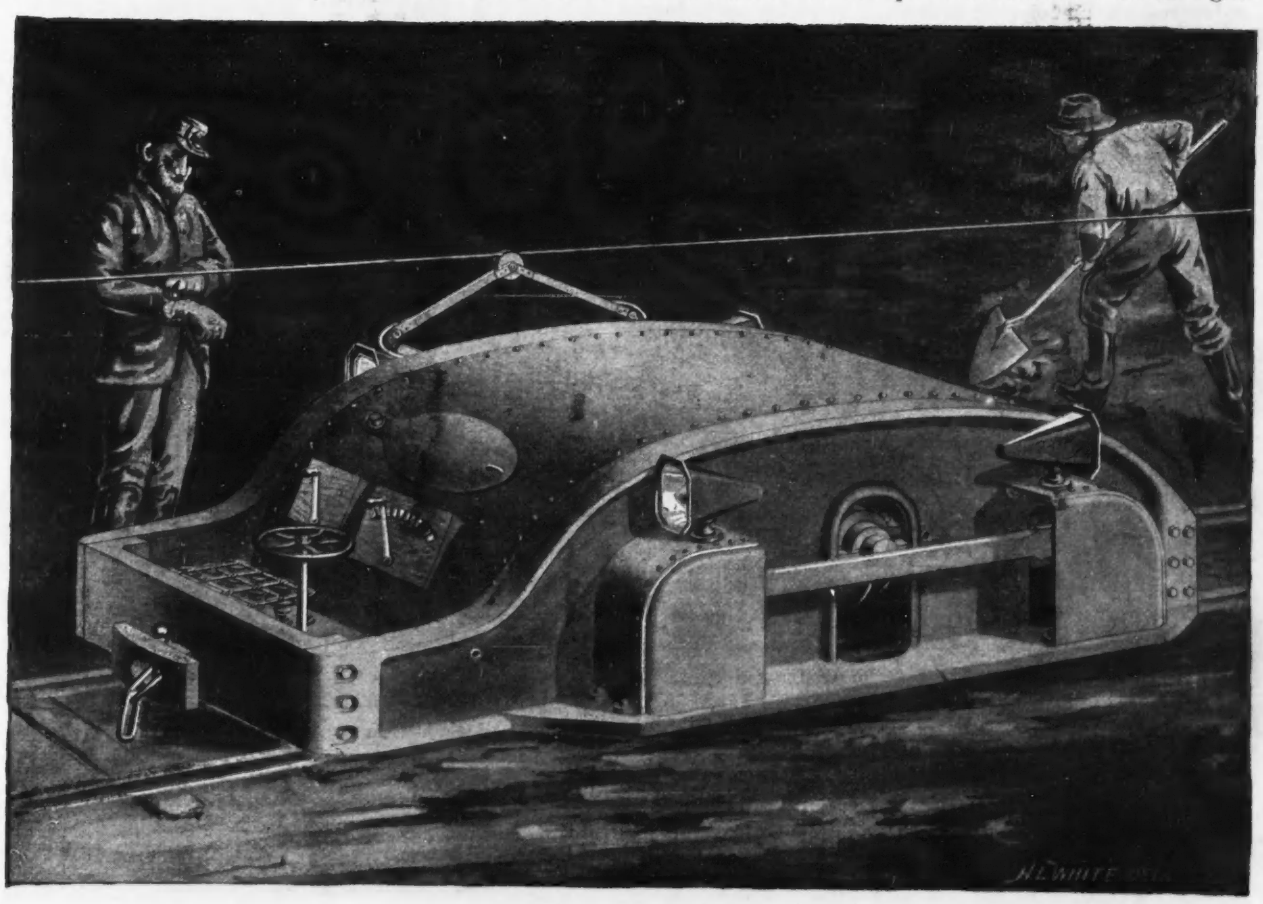
In the production of steel by the original Bessemer process, only pig iron free from all but a very small amount of phosphorus could be used, owing to the facts that phosphorus has a most deleterious influence on the finished metal, and that it was not eliminated in the natural course of events. By the substitution of a "basic lining" (*i. e.*, one composed of material such as magnesia) for the "acid lining," composed of siliceous matter, such as sand or ganister, it was found possible to remove the phosphorus owing to its tendency to become oxidized to phosphoric acid and combine with the basic material. It therefore seemed probable that the same device would be applicable in the case of copper for the removal of the arsenic—the electrician's *bête noir*. The high price of copper of good conductivity mainly depends on the cost of the elimination of those impurities which are, perhaps, more objectionable for electrical purposes than for any others.

Mr. Gilchrist's experiments have taken practical shape, and at least one big copper company is using furnaces with basic linings. Speaking generally, the value of the process lies rather in the elimination of arsenic more readily and at a cheaper rate (less copper passing into the slag and having to be reworked) than in any extraordinary perfection in the refined product. Its adoption should, therefore, lead to a reduction in the price of copper of good, but not abnormally good, conductivity, rather than to the attainment of any remarkably low resistance. Since it has become common practice to specify 98 per cent. conductivity, and such a conductivity being easily attained, manufacturers would do well to try and reduce the cost rather than to attempt to produce an article of greater purity but at a higher price.

A New Mining Locomotive.

The accompanying illustration shows the new type of Thomson-Van Depoele electric mining locomotive for underground work, built by the Thomson-Van Depoele Electric Mining Company, of Boston. The machine shown is of 60 h. p. capacity and has a total height of 39 inches from top of rails. It is built for operation on tracks of various gauges from 36 to 56½ inches.

The controlling devices are all at one end, and the body of the locomotive being so low that the view is unobstructed in either direction, the operator need not change his position in reversing the motion of the locomotive. Parabolic reflectors are provided behind the electric lights at each end, making the track clearly visible for long distances. The trolley is of the double elbow pattern which has already been found admirably suited to mine installations. It accommodates itself to the varying heights of the trolley wire within any reasonable range. The sheet-iron covering makes a complete water-tight armor, protecting the moving parts from danger of falling rock or bodies of ore and coal. The illustration shows the locomotive in an enlarged chamber, but about to enter a tunnel whose height from top of rail is scarcely four feet, hence the depression of the trolley wire as shown.

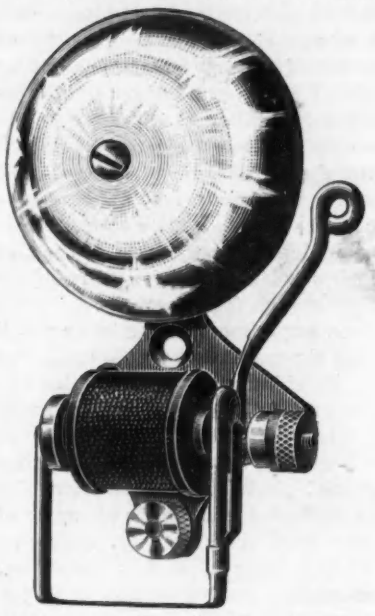


NEW MINING LOCOMOTIVE.

*From *The Electrician*, London.

A New Electric Bell.

An electric bell having a frame made entirely of soft cast iron is shown in the accompanying illustration. It is placed upon the market by the Walter Hay Manufacturing Company, of Chicago. One continuous wire of Norway iron forms the spring, the armature, the hammer and the screw which holds the magnet. All parts are nickel plated except the cast frame and magnet. The bell is also provided with platinum contacts. The binding post at the right of the bell forms a check nut when clamped against a wire and this prevents the contact screw from turning.



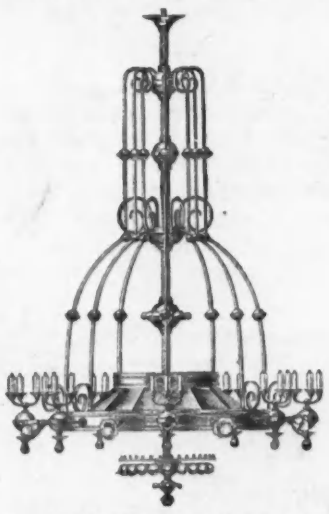
THE WALTER HAY COMPANY'S BELL.

The bell is made in three sizes, namely, 2½, 3½ and 5 inches. It is simple in construction and durable in actual service, and it is claimed that it is highly economical.

Frink's Reflector for Large Chandeliers.

The incandescent system of electric lights is now generally adopted for lighting all of the better class of churches, halls, theatres and public buildings throughout the country, but the lamps have been distributed usually with little regard for the utilization of the light produced. Mr. I. P. Frink, of this city, who has made a life study of the proper diffusion of light, has recently given his attention to the construction of reflectors and reflecting chandeliers for use with the incandescent lamp. How well he has succeeded is best attested by the many theatres and churches that have been brilliantly and properly lighted.

We illustrate on this page one of his latest fixtures, a combination gas and electric reflecting chandelier suitable for lighting the larger and finer class of assembly rooms.



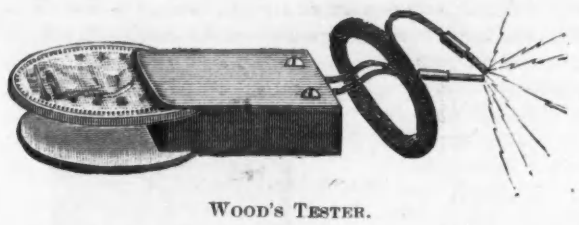
FRINK'S CHANDELIER REFLECTOR.

They are made in sizes from 72 to 106 inches in diameter, with from 51 to 90 gas burners and 34 to 60 incandescent lamps. This fixture has a reflector incorporated in its construction in such a manner that its appearance is graceful, and the lights being placed both underneath and outside of it, the illumination is both general and effective. Mr. Frink manufactures reflectors for every conceivable use, including the lighting of art galleries and for use on centre poles in electric street railway construction.

A Simple Scheme of Testing.

This piece of apparatus is intended for the use of bell-hangers, prospectors, miners, amateurs and others who are engaged in the construction and repair of electrical circuits, and is designed for testing for faults in wire circuits, such as crosses, breaks, grounds, etc., and for testing for mineral in rock or earth. By referring to the cut it will be seen that the instrument consists of a silver coin and disc of zinc held in place on a rubber insulator by means of spring contact pieces with flexible cord attachments. The coin and zinc are removable and can be attached and detached at will. When the tongue is placed between the coin and zinc disc, and a circuit is formed through a coil of wire or otherwise, or by touching the ends of the flexible conductors together, a small current of electricity is generated and a slight burning sensation is felt on the tongue.

With this little apparatus, which is placed upon the market by S. C. Wood & Co., of 174 Centre street, this city, and which is of a convenient size to be carried in the vest pocket, the prospector or miner can test in a minute's time any piece of rock that may be liable to contain mineral. A dynamo or motor may be tested for a ground or short

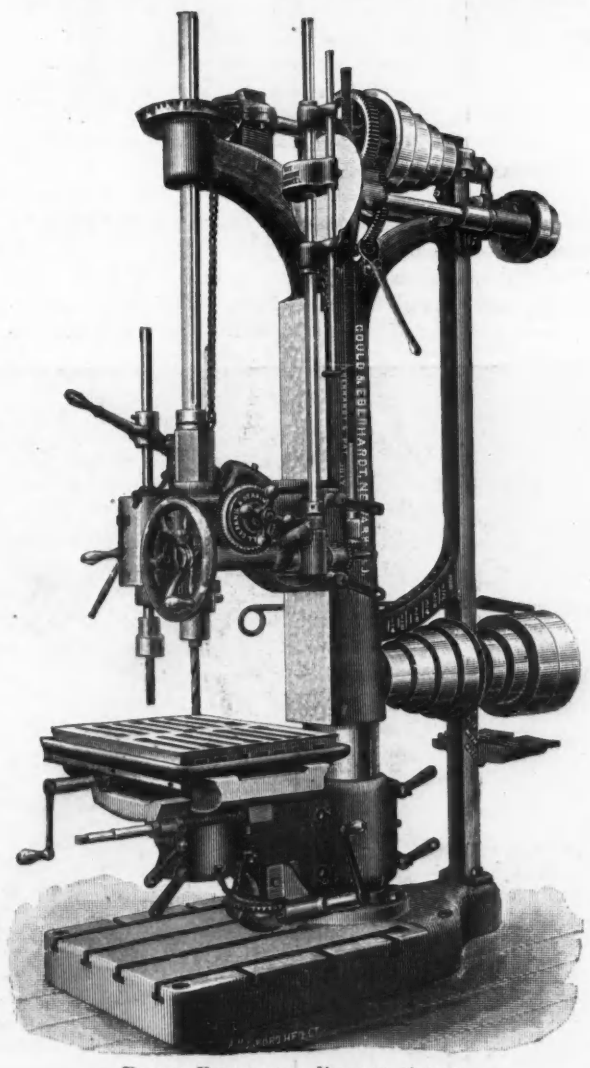


WOOD'S TESTER.

circuit through the field or armature core without any loss of time. The bell-hanger can test his wires in buildings without the use of battery bells or galvanometers.

A Drill Press for Electrical Repair Shops.

In the accompanying illustration is shown one of the standard drill presses of Gould & Eberhardt, of Newark, N. J. As a press of this kind is required in nearly every repair shop connected with an electric railway or power plant, a description of this style will be of interest to managers of such plants. One style is made having a tapping attachment secured to the sliding arm, also a compound drilling table, which swivels in the table arm, giving the operator a universal movement by which to adjust his work. This arm is raised and lowered by screws and gears, under the centre of the work, which is thereby always kept true and not liable to sag down. Another style has the compound table with similar improved device and also had a drill and tap closet neatly arranged between the columns, with suitable door, lock, etc., and also has a twist drill grinder attached, so that the workman running the machine is not dependent on any tool room or tool boy for his tools. One of these machines is arranged with two friction clutch pulleys and back brace, and is advantageous where large holes are to be tapped.



DRILL PRESS FOR REPAIR SHOPS.

The Comparative Efficiencies of Dynamos and Thermopiles.

Two easily remembered figures permit us, says the *Bulletin de l'Electricité*, to form a clear idea of the relative value of a thermopile and a dynamo driven by a gas engine as an apparatus for the transformation of the thermic energy of combustion of coal gas into electrical energy. In all tests of thermopiles heated by gas the consumption has, up to the present, exceeded 3,000 litres per kilowatt per hour (1 5 cubic feet per kilowatt hour). A good gas engine consumes from 600 to 700 litres (21 to 23.5 cubic feet) per B. H. P., and for this consumption we may obtain 600 available watts from a dynamo having 85 per cent. efficiency, and this is equivalent to 1 litre (.035 cubic feet) per watt hour, or 1 cubic metre (35.3 cubic feet) per kilowatt hour. Hence for a given amount of electrical energy a good thermopile requires three times as much gas as a dynamo driven by a gas engine. We may add that no commercial thermopile exists of more than 10 or 12 watts, while 100 horse power gas engines are now constructed.

The New Sloane Cell.

We present herewith a cut of the new Sloane open circuit battery cell manufactured by the Bird & Sloane Electric Construction Company, of Boston. This cell has been subjected to some very severe tests, and it is claimed that it

SLOANE'S PRIMARY CELL.

has proved equal to them all. A record of 18 months without recharging, ringing from 15 to 20 magneto bells, is claimed for this cell.

Long-Lived Westinghouse Lamps.

Mr. R. L. Cahen, of Camden, N. J., reports that in a paper mill in that city where a 50-light incandescent plant was installed in July, 1887, two 100-volt 16 c. p. lamps having an average use of 14 hours daily are still giving good light, the bulbs having darkened but slightly during this long run.

An Electro-Pneumatic Thermostat.

A thermostat designed for use in theatres, warehouses and other places where such apparatus is used for fire-alarm purposes is shown in the accompanying cut. It is placed upon the market by Edwards & Co., of this city. The thermostat is made entirely of metal and strongly constructed; its action is positive, operating by the expansion of air. When connected and subjected to heat the air expands and causes a diaphragm to move a rod resting on a spring underneath the base, and by this

AN ELECTRO-PNEUMATIC THERMOSTAT.

means the electric circuit is closed and a bell placed in any desired location is rung. An annunciator can also be used to show the exact location of the fire if necessary.

Franklin Experimental Club Dinner.

The first annual dinner of the Franklin Experimental Club, of Newark, N. J., took place in the laboratory of the association last Saturday evening. The affair was managed by Mr. W. J. Hammer, of this city, whose ability to produce unique electrical effects of an amusing as well as instructive nature is well known.

The dinner was a complete success in every way, and its many pleasant features, which sometimes resembled experimental demonstrations and at others produced serious or ludicrous effects by means of the phonograph, the telephone, the electric light, the action of electromagnets, etc., were very enjoyable to the guests. The dinner was adjourned at 11 o'clock, when Ben Franklin's bust, which presided at the head of the table, announced in serious tones to the jolly banqueters that "Early to bed and early to rise makes a man healthy and wealthy and wise."

Among the people who shared in the electric feast were Mayor Haynes, of Newark; Edward Weston, F. J. Sprague, Francis R. Upton, James M. Beck, Assistant District Attorney of Philadelphia; Theodore Van Wyck, Senator Michael T. Barrett, William Wallace; R. F. Outcault, of THE ELECTRICAL WORLD; Dr. T. W. Corwin, vice-president of the Club; Secretary F. W. Hillard, Prof. George C. Soun, Superintendent of Public Schools; W. N. Barringer and Lyndon Bryce, Secretary of the Board of Educaton.

Recovering from the Storm.

Notwithstanding the extent of damage wrought by the storm of the early part of last week, the telegraph and telephone lines are now in fair running order, and the people of the metropolis should be very thankful that New York City has such efficient forces in the telegraph and telephone ranks.

Mr. Thomas Brennan, of the Western Union Telegraph Company in this city, gives the following résumé of the trouble: "On Monday, the 26th ult., all lines east, west and south were broken, and from the Hudson River northeast, and in New Jersey, the devastation was general, including the wrecking of the lines of the New Jersey Central Railroad, the Baltimore & Ohio Railroad, the East River Railroad, the Delaware, Lackawanna & Western Railroad, and the Pennsylvania Railroad. The wires of the New York Central Railroad, the New York & New Haven Railroad, and of the Harlem road, were also down in many places, and the morning of the 26th found the circuits of the lines between New York and Poughkeepsie (on the New York Central Railroad), and between Croton Falls and New Haven (on the New York & New Haven Railroad), in a complete wreck. All of the lines now, however, are in a good working condition. East—in Long Island —all the lines were crippled, but in Brooklyn and in Long Island City we have our lines up and in a few days will have straightened out all the other Long Island circuits. The greatest damage has been in the immediate neighborhood of New York. The Philadelphia district is in nearly as bad condition, and lines leading from Boston along the coast to Maine have been badly wrecked."

A prominent electrician of the Metropolitan Telephone and Telegraph Company gives us the following account of the telephone troubles and of the work of repair: "Since the storm of last Sunday the Metropolitan Telephone and Telegraph Company has had an immense force of men at work, and has made substantial progress in the work of reconstructing its plant. The Thirty-eighth street district suffered the most, but as the company has a comprehensive system of underground work almost ready to put in operation, the loss will not be so serious as would seem at first; but the work of connecting in underground cables and making joints cannot be carried on rapidly, so there must be considerable delay before service is restored. In the Cortlandt street district, where the underground system is in operation, there remain but a few hundred wires out of order. At Harlem, Spring street, and 18th street exchanges, an immense amount of work must be done. In many cases cables were broken off where they left the subways to connect with the overhead construction. The work of repair is being prosecuted with all vigor, and the company is sparing neither men nor money to put the service even in better shape than before. One of the effects of the storm has been to show to the subscribers how helpless they are without the telephone, and to illustrate one of the immense contingent expenses for which the telephone company must prepare."

Mr. M. R. Brennan, deputy superintendent of the New York Police Telegraph system, states that a large number of tall poles were blown down, generally interrupting the system, but the prompt action of the department soon had everything in good working order.

Mr. J. J. Moore, of the East River Electric Light Company, says: "The electric light people have met with comparatively small damage by the storm, the principal trouble experienced by us being but two poles wrecked. We are now in perfect order.

"My opinion is that the lesson to be taken from last week's storm is that no tall signal poles reaching above the housetops, with their immense palms of cross arms exposed to the wind, should be used. Short poles with short cross-arms bearing bunched cables would seem to be advisable. I think that a good effect of the storm will be that the pole lines of New York City will receive a much-needed dressing."

Street Railway Line Appliances.

In the accompanying figures are shown two pieces of apparatus for street railway line construction which have recently been placed upon the market by Pierce Bros., of Leominster, Mass. Fig. 1 shows an inverted switch of very simple construction. As will be seen, the trolley wheel when advanced on either of the diverging lines automatically throws the hinged portion of the switch over to the end of that line. This is done by a simple arrangement of the arms, so that the flange of the wheel striking the arm brings the movable portion of the switch into the required position. The switch is made of only two pieces, is entirely of metal, and the line passes over its back without the necessity of any cutting whatever.

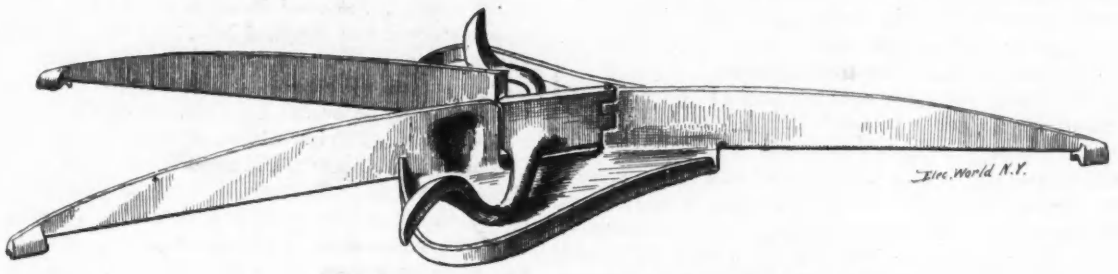


FIG. 1.—PIERCE BROS.' OVERHEAD TROLLEY SWITCH.

Fig. 2 shows a span wire insulator of new design, brought out by the same parties. It is made of malleable iron, of the well-known bell patent, and has a cavity in its interior, in which is placed a porcelain insulator of the ordinary type. This is held in position by an insulating compound, which is poured around the porcelain while hot, and filling the grooves in the sides of the bell chamber and on the side of the porcelain, holds the latter firmly in position. In other respects the insulator is similar to others of the same company's manufacture already in use. In actual service it has proved very strong and durable.

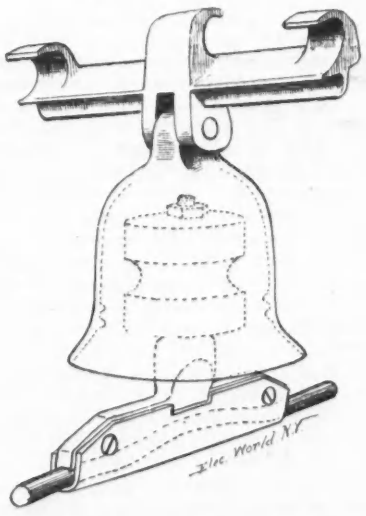
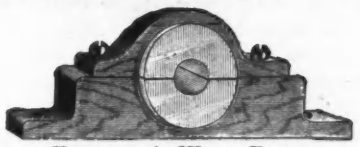


FIG. 2.—PIERCE BROS.' SPAN WIRE INSULATOR

Fletcher's Wood Risers.

The device here illustrated was designed especially for running bare and insulated wires or copper rods in electric light stations and power plants, but there is also other nice interior wiring for which it will be found very convenient. It is placed upon the market by The Electrical Supply Company of Chicago.



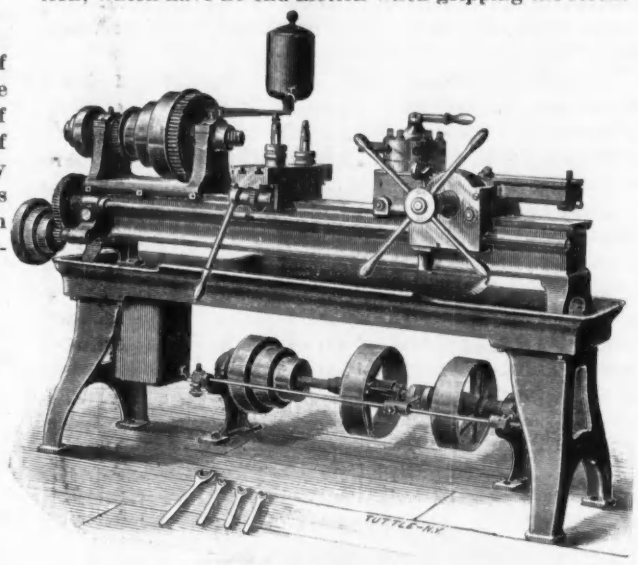
FLETCHER'S WOOD RISER.

It complies fully with underwriters' rules, and is a handsome and efficient insulator. The base is smoothly finished maple. In the sizes with ⅛ and ¼ inch opening the insulator is porcelain. For larger sizes, opalescent glass is used.

The Electrical Supply Company of Chicago is prepared to furnish them in any quantity.

Improved Screw Machine.

There is probably no manufactory of electrical apparatus, whether large or small, that is not equipped with machines for turning out the great variety of screws used in dynamos, motors and electrical instruments of various kinds. To users of these machines the accompanying illustration and description will be of interest. This screw machine is manufactured by the Garvin Machine Company of this city.



SCREW MACHINE.

It comprises the latest designs in this class of machines, of which the company manufactures a very complete line.

The screw machine is known as the No. 3 size, and has a 14 inch swing, with a 4½ foot bed. It is arranged with power feed and automatic stop; the feed rod and connections are placed on the front of the lathe for convenience in handling. The feed is tripped by means of an adjustable dog, carried on top of the turret slide.

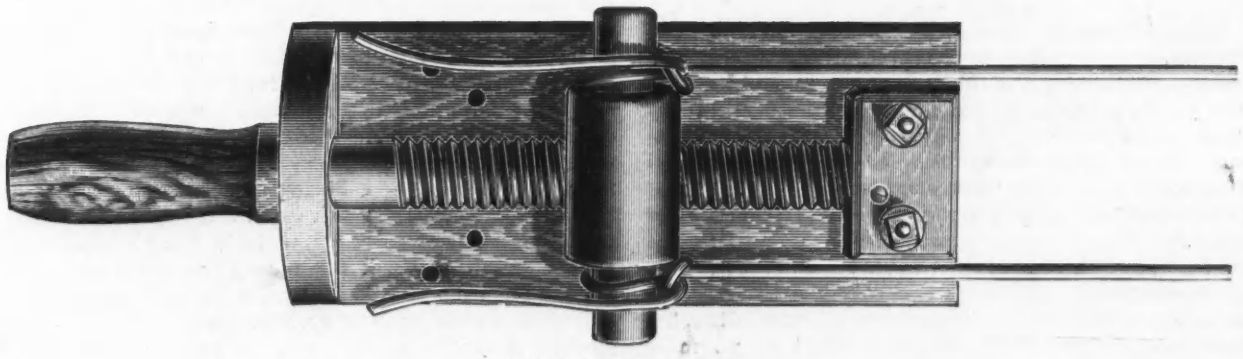
The spindle runs in composition boxes and has a 1½ inch hole its entire length. The outer end of the spindle is threaded for chucks, or is made with automatic spring chucks and wire feed. The wire spring chucks used are of a new pattern, which have no end motion when gripping the stock.

The turret is 8 inches in diameter, with eight 1¼ inch holes for tools, and has a movement of 12 inches. The cross slide is made with rack or screw feed, and with a stop for each tool. The head is made as shown, with back gears, or with plain cone, or with back gears and friction clutch. The friction clutch head admits of changing instantly from fast to slow speeds, or stopping, as desired. This is particularly valuable when using large dies, or when different parts of the work vary largely in diameter.

This machine is also made with extra large spindle, when desired, which gives a 2⅛ inch hole in the spindle, or a 1½ inch hole with wire feed and spring chuck. The pan for chips is especially large, and has a side extension where chips accumulate, with an oil pot at the end, where it is not liable to become clogged. The countershaft has self-oiling boxes, with friction pulleys 14 inches in diameter and 4 inches on face. The total weight of the machine, complete, is 1,600 pounds.

An Electric Wire Stretcher.

Wiremen and all parties who are doing inside wiring for arc or incandescent systems will appreciate this exceedingly neat and efficient device for pulling up inside lines of wire. It is claimed that by using this device one workman can in the same length of time do much more work than under ordinary circumstances, and put up even No. 4 B. & S. wire as taut as No. 16, and that it also enables him to work with porcelain rosettes, etc., with as much ease as with wood.



WIRE STRETCHER.

As will be seen by the illustration, the apparatus consists of a wooden support upon which is mounted a screw and traveler, to which the wires are attached, after having secured the stretcher to the ceiling by means of two or three ordinary wood screws.

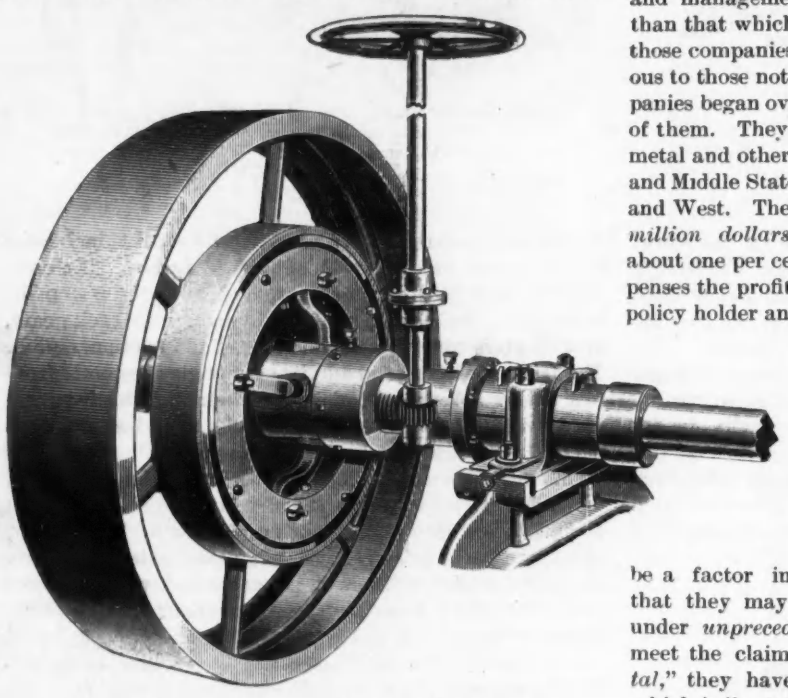
The further ends of the wires having been previously secured to the ceiling at the other end of the span by means of a cleat or porcelains, all that remains to be done is to turn the screw by its handle until all kinks are out of the wire and it is perfectly taut; then the rosettes and cleats are placed and secured in their proper position, the stretcher is taken down and the next span operated in the same manner. To stretch single or arc wire all that is necessary is to secure a piece of 3-16 or ¼-inch braided rope about eight feet long, make an endless loop of it, braid this loop over the wire to be stretched until sufficient grip is secured, then pass either end of the loop over the ends of the traveler, and then pull up the wire by means of the screw as before.

Rice's Patent Friction Clutch Pulley.

The friction clutch pulley herewith illustrated was invented by A. C. Rice, superintendent of the works of the Stilwell & Bierce Manufacturing Company, Dayton, O. His wide practical experience and high standing in his profession will commend his invention to the careful consideration of all who have occasion to use friction clutch pulleys and couplings.

The cut represents one of Rice's friction clutch pulleys attached to a shaft and thrown into gear. The clutch is shifted in and out by means of an upright shaft terminating in a pinion, which engages in a rack cut in the side of the shifter sleeve extension. This shaft is provided with a hand wheel, and may be extended so as to operate the clutch from any floor, above or below. The ordinary shifter fork and lever can be used if preferred.

The clutch is provided with four metal friction shoes, which are simultaneously operated by the four crooked shifter arms. Each of these shifter arms is fulcrumed on an eccentric bolt, the end of which only is seen. The centre of each friction shoe is out of centre with its corresponding eccentric bolt, the effect of which is, that when the friction shoe is thrown out against the friction rim, the shoe acts as a wedge, increasing the friction of the two surfaces just in proportion as the load is increased. Each shifter arm is provided with an anti-friction roll running in the inclined slots in the shifter sleeve, which makes it easy to operate. These inclined slots terminate at both ends in straight slots parallel with the shaft, which serve to lock the shifter arms



Rice's Patent Friction Clutch Pulley.

and prevent all friction whatever on the shifter sleeve caused by centrifugal force when running, and consequently all tendency to throw in or out.

The clutch is positive in action, perfectly balanced, and has been found durable and highly satisfactory in operation.

First Annual Report of the Electric Mutual Insurance Company.

In the first annual report of the Board of Directors, Mr. Stephen E. Barton, their president, says: The causes which induced the formation of this company were the following: The exorbitant rates and exacting conditions imposed by stock companies—the difficulty even of procuring necessary reliable insurance in those companies on electrical risks, together with the vacillating action in the matter of rates, which are subject to the whims and prejudices of local boards and compacts, and also the realization that the enormous capital invested in electrical industries requiring insurance called for a company of its own. The unfairness of the stock companies' rates (notwithstanding their protestations to the contrary) can have no more potent demonstration than the present alacrity with which they are now *reducing* them *almost one-half* wherever and whenever they feel the competition of our company. Such reductions are not made, however, until our competition is felt.

About the first of January, 1890, a prospectus was sent out setting forth the purposes and prospects of the Electric Mutual Insurance Company and calling for pledges of insurance to secure incorporation and authority to begin business under Massachusetts law. Not less than $500,000 insurance, covering at least 200 separate risks, was required. More than double the amount was pledged, and an organization and incorporation was at once effected. The company issued its first policies on the 15th of May. This report covers the operations to the close of business, Dec. 31, 1890—7½ months.

By the treasurer's report you have seen that the outstanding risks amount to the large sum of $2,897,587, the premium on which is $30,320.71—an average rate of about one and one-fifth per cent. The average amount of policies is $9,055. The actual cash assets, after paying every dollar of taxes, expenses (including costs of organization, equipment of office, etc.) and losses, amount to $18,907.04, a result, we believe, that is unprecedented in the formation of mutual fire insurance companies.

Not a risk has been assumed that has not either been personally examined by a representative of the company, or the fullest detail and description submitted by the member insuring, in writing, upon blanks of the company provided for the purpose. Not a risk is outstanding that has not been improved electrically (where improvement was needed), nor that is seriously exposed or without good facilities for extinguishing fire. Nothing can better attest those facts than the statement that not a dollar of loss has occurred on any station insured.

If the experience of the company during the first eight months continues to the end of the first year, we shall be able to pay back to members 50 per cent. of the premium paid for their policies, and add to our reserve besides.

We are pleased to say that a most satisfactory arrangement for exchange of business with several of the factory mutuals was concluded shortly after we began operations, and by which arrangement surplus insurance secured by this company, amounting to over $1,500,000, has been placed with those companies, at the same rates charged by this company. In return about $800,000 insurance on isolated manufacturing properties fully provided with automatic sprinkler equipments, pumps, hose, etc., insured by them, has been placed with this company.

We could ask no stronger endorsement of our methods and management nor of the desirability of electrical risks than that which is manifested by the ready alliance of those companies with us. Their record will seem marvelous to those not familiar with it. The first of those companies began over 40 years ago and there are now about 25 of them. They insure the large cotton, woolen, paper, metal and other manufacturing corporations in the Eastern and Middle States and to considerable extent in the South and West. Their insurance aggregates over *five hundred million dollars* annually, the cash premium averaging about one per cent. After the payment of losses and expenses the profits have enabled them to pay back to each policy holder an average of about *seventy-five* per cent. of the cash premium paid for the policy, so that the actual cost of insurance has been only *one quarter of one per cent. or less* annually.

They have in the meantime reserved of their earnings from year to year funds ranging from $50,000 to $900,000 each, thus making the contingency of an assessment so remote as to hardly be a factor in their calculations. In order, however, that they may be in position to pay their losses even under *unprecedented and unexpected disaster*, and to meet the claim of competitors "that they have no *capital*," they have a "contingent, or assessment liability," which is limited to five times the cash premium. Their loss-paying resources are, therefore, about six times their annual premium receipts, as they have always at least one year's premium in hand. It is, perhaps, needless to say that in their whole existence (dating back 40 years) they have never called upon the assessment obligations.

Precisely the same plan was adopted in the formation of the Electrical Mutual.

Many of the electric stations throughout the West we find have been compelled to insure with those concerns by reason of the excessively high rates imposed by stock companies and their reluctance to take the risks even at their own rates.

Several fires have occurred in electric stations, but nearly all have been traceable to carelessness of construction or failure to provide any facilities for the extinguishing of fire, faults due wholly to the unusually rapid development of the industry. A more deliberate, permanent and extensive era of construction has set in, and the mistakes and neglects of the past are not being repeated.

Your board feels that you and those engaged in electrical development generally will not fail to appreciate the good results that will follow and the fire losses that may be avoided by the dissemination of practical and valuable ideas pertaining to safety, through the intelligent inspection of its risks by an insurance association devoting itself especially to the electrical business. The excellent results obtained by the factory mutuals have been due to the avoidance of "normal hazard" by their careful selection of risks, and intelligent inspection of the same, coupled with the interest that each insurer has in the welfare of the companies.

There is surely no other industry whose best interests can be served to so great a degree by the absence of fire loss as can the electrical; and therefore we feel confident of the wisdom shown in following the lead of those mutual companies whose plans we have adopted and with which we are so agreeably working.

The business written by the Electric Mutual thus far in January swells its premium income to thirty-four thousand dollars, with every indication that the month will show an increase over the preceding month, which has been the case with each month since we organized. Adding the normal increase of new business to the renewals after one year shall have passed, there is good reason to anticipate not less than one hundred thousand dollars premium income during our second year.

Edison Illuminating Company's Annual Report.

The report of the president of the Edison Electric Illuminating Company, of New York, to the stockholders of the company at their annual meeting, contains some interesting statistics of the growth of the business since 1884, and a very complete résumé of the present equipment of the company's stations. The following table shows the increase in gross and net earnings in the last seven years and the growth of the business in other respects:

	Gross.	Net.
1884	$111,872.57	$33,222.54
1885	131,332.99	51,551.76
1886	157.579.86	70,051.05
1887	191,635.39	89,069.96
1888	226.301.76	116,235.26
1889	327,678.99	124,031 97
1890	488,595 83	229,078.80

	1888.	1889.	1890.
Number of customers	710	1,213	1,698
Number of lamps, 16 c p	16,377	39,815	64,174
Number of motors, h. p		470	697

Concerning the present capacity of the company's stations, the report has this to say: "The reconstructed station (taking the place of the Pearl street station, destroyed by fire) has about the same plant capacity as the old, though of improved character, but to the total capacity of the district (which includes also the Liberty street annex), the new Produce Exchange annex, from which current was supplied Nov. 12, 1890, has added four No. 32 dynamos with a capacity of 2,300 ampères, or 5,000 16 c. p. lights. The down-town district has now a maximum capacity of 10,750 ampères, or 23,369 lamps of .46 ampère each. The installation of incandescent lamps, and their equivalent in arcs and motors, is already much above these figures, but all are never in use at one time. With the completion of the improvements in progress in the down-town district, this district should be able to install the higher efficiency lamp used up town. The maximum output of this district in 1889 was 7,250 ampères; in 1890 8,340 ampères. Its best daily average in 1889 was 2,760 ampères; in 1890, 3,382 ampères.

"The second district, in which one 'unit' (viz., one 250 h. p. engine and two No. 32 dynamos) has been added, making a maximum capacity of 6,900 ampères or 16,428 lamps of .42 ampère each, showed in 1889 a maximum output of 3,715 ampères and in 1890 of 6,300 ampères. Its best daily average in 1889 was 1,296 ampères; in 1890, 2,137 ampères.

"In the third district, from which one 'unit' was withdrawn at the time of the Pearl street fire, the output has not yet approximated its present capacity, but it has increased its maximum output of 1889, 1,440 ampères, to a maximum in 1890 of 2,745 ampères, with a best daily average in 1889 of 495 ampères and in 1890 of 1,005 ampères."

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

Railroad Share Market Still Dull.—A glance at the ticker from day to day during the week showed a decline in railroad share speculation. If such is not the case, why is it that although all the conditions are favorable at this time and bank statements and all other signs point to a rising market we find it to be exceedingly dull and lifeless? All the excuses that can be conjured by financial writers regarding railroad stocks fail to demonstrate the true state of affairs. These writers have been looking for a rising market for some time past. What is the matter? Why is it, with money plenty, the condition of the London market satisfactory (and of late it seems that the demand for railroad shares is dominated here by the English market for them) there is no improvement in the market? The fact is apparent. The demand for railroad shares is lessening gradually but surely.

The investment bond business on the other hand is growing rapidly, and bonds are in greater demand than ever. Right in this line is a good chance for the electrical investment business. If electrical companies will capitalize low and issue bonds which are the representatives of cash expended the market now is in condition to take them.

Electric Street Railway Bonds.—Particularly is there a demand for good electric railway bonds covering street railroads in towns of 25,000 or more inhabitants. It is the opinion of the writer that bonds on good electric railway properties are among the best securities offered in the market.

Electric Light Bonds.—This class of bonds has been damaged to a great extent by unscrupulous persons who have knowingly overbonded electric plants. The good suffer for the bad, and it should not be so. Many electric light bonds are paying their interest regularly and principal when due.

Judges of Good Electrical Securities.—Some investors are of the opinion that a knowledge of the electrical business is necessary in order to judge properly of the value of electrical bonds. Such is not the case. Good experts are to be had who will give unprejudiced opinions and will quickly demonstrate the worth of the investment. There is no good reason for making a bad investment in electric light bonds. It is a question of how many lights can be put in and how much it costs to run the plant. The former can be answered by personal investigation and the latter by experts or any of the electric companies selling electric light apparatus. There is no unusual risk about the investment whatever, and the chances for investigation are abundant.

The Wenstrom Company.—This company, we understand, is in a highly flourishing condition. It has just got into its new factory, which is very large and complete, and will be turning out apparatus at a very rapid rate in a short time. The success of this company from apparently small beginnings has been remarkable. Wenstrom sold his patents originally to Dr. De Lery, a gentleman well known in electrical circles. It was not long before a strong company was organized in Baltimore, and among the directors were some of the most prominent men of that city. A northern company was also organized, with headquarters in New York. The two companies have since been consolidated, and have been

fortunate in the accession of large capital. Mr. E. L. Tunis, o Baltimore, has been very successful in the direction of this new company, and a large amount of stock was disposed of at good figures. One great embarrassment to the company has been its inability to supply orders while awaiting the completion of its new factory. It will now, however, be properly prepared to turn out machines. The success of this company shows how it is possible to build up a business quickly by means of good management and capital sufficient to do business properly. There has been considerable demand for the stock of late at increased prices over the ruling figures three months ago, and it is believed that the stock will rise steadily for some time to come.

Electric Stocks.—The course of these stocks has been very satisfactory during the week. There has been a good market and prices have been inclined to advance. Westinghouse stock closed Saturday at 13¾ in Boston and had an active market. Thomson-Houston has risen from 43 in last report to 48½. Fort Wayne Electric made a jump of 1½, which counts rapidly owing to the par of the stock being only 10. Edison stock on the increase of capital stock lost three points since last report. F. Z. M.

The Closing Quotations of electric stocks, from F. Z. Maguire & Co., electrical securities, 18 Wall street, New York, on Saturday, Jan. 31, 1891, in New York, Boston and Washington, and in Pittsburgh Jan. 30, were as follows:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
NEW YORK.				
Western Union Telegraph Co.	100	86,200,000	79⅛	79½
American Telegraph & Cable	100	14,000,000	83	85
Central and South American	100	5,600,000	145	160
Mexican	100	2,000,000	210	....
Commercial Cable Co	100	7,716,000	104	108
Postal Telegraph Cable	100	5,000,000	39	41
Edison General Electric Co	100	9,503,500	92	95
" " Deferred	100	2,496,500	....	....
Consolidated Electric Light	100	1,922,400	....	....
Edison Electric Illuminating Co.	100	2,567,800	70	....
United States Electric Light	100	1,500,000	30	....
North American Phonograph	100	6,200,000	....	....
BOSTON.				
Thomson-Houston Electric Co.	25	6,000,000	48½	48¾
" " preferred	25	4,000,000	....	25¾
" " Series C.	10	400,000	....	....
" " Series D.	10	120,000	5⅞	6
" International Co.	100	1,000,000	....	....
Thomson Welding Co.	100	1,000,000	....	199
" European Welding Co.	100	1,000,000	....	....
Ft. Wayne Electric Co.	25	4,000,000	12½	12¾
Telephone:				
American Bell	100	12,500,000	185¼	185½
Erie	100	4,800,000	49¼	49½
New England	100	10,504,600	52	....
Mexican	10	1,280,000	70c.	80c.
Tropical American	10	400,000	....	1.20
MISCELLANEOUS.				
Edison Phonograph Doll	10	1,000,000	1	1½
WASHINGTON.				
Pennsylvania Telephone	50	750,000	25	....
Chesapeake & Potomac	100	2,650,000	63	....
American Graphophone	10	600,000	8¼	....
United States Electric Light (Washington)	100	300,000	138	150
Eckington and Soldiers' Home Electric Ry.	50	352,000	55	60
Georgetown and Tennallytown	50	200,000	50½	60
PITTSBURGH.				
Westinghouse Electric Mfg. Co.	50	5,000,000	13¾	13⅞

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on Telephone stocks as follows:

Chicago	$250@$280	Cumberland	$60@ $62
Central Union	56@ 58	Wisconsin	118@ 120
Michigan	90@ 91	Bell of Missouri	160@ 165
Great Southern	30@ 32	Iowa Union	20@ 22
Colorado	34@ 36	Missouri and Kansas	54@ 56
Rocky Mountain Bell.	40@ 43		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$90@ 95	Chicago Edison	$130@ 135

NEW INCORPORATIONS.

The Morrisonville Electric Light Company has been incorporated at Morrisonville, Ill., with a capital stock of $4,000, to furnish electric lights. The incorporators are H. C. Bohn, J. W. Campbell, E. D. Green and A. E. Gowin.

The Chicago Insulated Wire Company, of Chicago, with a capital stock of $50,000, has been incorporated for the manufacture of bare and insulated wire and insulating materials, the incorporators being William G. Adams, Herman W. Plautz and Paul Brown.

The San Francisco and San Mateo Railway Company has been incorporated to build an electric road along the route of the franchises granted to B. Joost *et al.* by San Francisco and San Mateo counties. The capital stock is $2,000,000, of which $10,000 have been paid up.

The North American Electric Company, at Chicago, has been incorporated with a capital stock of $100,000, for the manufacture of motors, car trucks, batteries, lamps, and electrical appliances generally. The incorporators are J. H. Donnelly, Frank J. Lally and Myron H. Beach.

The Chicago Electric Protective Company has been incorporated at Chicago with a capital stock of $100,000. The company is to deal in electrical supplies and to operate fire and police alarms and patrols. The incorporators are Mark Simons, Walter M. Lawney and Frank S. Wiegley.

The Princeton (Ill.) Electric Light and Power Company, with a capital stock of $15,000, has received papers of incorporation to furnish electric light and power and to construct a motor line. Incorporators are H. H. Ferris, David Knight, J. A. Stern, D. B. Loverin, D. E. Munger and H. H. Priestly.

The Chartiers (Pa.) Electric Light Company has been granted a charter and proposes to erect an illuminating plant in Chartiersborough, Allegheny County, Pa. The directors of the new corporation are: Messrs. Daniel Healy, Robt. McMunn, Presly W. Munn, Christopher Durham and John Lee, all of Stoe township, Allegheny county, Pa.

The Moore Electrical Manufacturing Company, formerly known as Moore Bros., 106-108 Liberty street, this city, has been incorporated. The new company will undertake the manufacture and sale of electrical apparatus and supplies. The officers are: John L. Moore, president; Erastus E. Moore, treasurer, and James H. Bates, secretary.

The Mercantile Telegraph Company, of Chicago, with a capital stock of $100,000, has been incorporated to transmit intelligence to a distance by means of electricity and magnetism, to construct telegraph lines between the respective states and territories, and to engage in a general telegraph business. The incorporators are Julius Schwiezer, George Einstein and Henry H. Kennedy.

AFFAIRS OF THE COMPANIES.

The New England Telephone and Telegraph Company has declared its usual $1.25 per share dividend, payable Feb. 11 to stockholders of record Jan. 31.

The San Diego (Cal.) Electric Light and Gas Company has elected W. W. Stewart, E. H. Bushyhead, R. H. Dalton, E. Westcott and R. M. Powers, directors; R. M. Powers, president and general manager; F. W. Jackson, secretary; G. I. Kinney, superintendent; R. S. Clarke, chief engineer.

The Standard Underground Cable Company, one of the Westinghouse concerns, held its annual meeting on Tuesday of last week at the company's office in the Westinghouse building, Pittsburgh, Pa. A large number of stockholders was in attendance. Mr. George Westinghouse, Jr., was re-elected president of the company and the following gentlemen named as directors to serve for the ensuing year: George Westinghouse, Jr., Mark W. Watson, John H. Dalzell, Robert Pitcairn, Joseph W. Marsa, James H. Willock, H. S. Sweitzer. The company's business for the year 1890 amounted to $917,946.62, an increase of 50 per cent. over the business of 1889. The net earnings for 1890 were $204,913.78, a little over 20 per cent. on the entire capital stock. Two dividends aggregating $30,000 were paid during the year, leaving the net addition to the surplus account $174,913.78. The company's net surplus on Dec. 31, 1890, was $310,735.83.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Feb. 2, 1891.

Mr. J. F. O'Brien, of Montreal, Canada, is in New York introducing his telephone index, which is unique in its features and will immediately commend itself to popular use.

The Saugerties (N. Y.) Electric Light and Power Company has received an 80 h. p. engine, and it is being placed in position. Electric light will be furnished to consumers during the coming week.

The Storm.—Since 1880 there has not been such a generally destructive storm as that of last week. From numbers of States come reports of havoc done to wires that in many cases show that New York was not the only badly damaged place.

Magnetic Club Dinner.—The winter meeting of the club was held at Martinelli's, on Fifth avenue, in this city, on Wednesday evening of last week. A very enjoyable dinner was served to those in attendance, and a pleasant evening was spent by the members and their friends.

Mr. S. E. Barton, president of the Electric Mutual Insurance Company, of Boston, has been in the city for a day or two this week and has placed over $300,000 worth of risks while here. The annual report of this company, printed in this issue, is a remarkable one and should be read by all central station managers. L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.,
BOSTON, Jan. 31, 1891.

Laconia, N. H.—The Gilford Hosiery Mill is to be lighted by the incandescent system.

Derby and Chester, N. H., are making efforts to obtain an electric road to connect the two places.

The Thomson-Houston Electric Company, it is said, will declare a dividend on its common stock, payable about March 1.

Windsor Locks, Conn.—The electric light station is putting in an engine as an auxiliary to its water power, so as to be ready for emergencies.

The Brayton Petroleum Engine Company's works at East Bridgewater, Mass., it is rumored, are to be used for the manufacture of a storage battery for street cars.

Electric Light Convention.—The indications point to a large attendance and exhibit of the New England electricians, inventors and supply men at the forthcoming convention at Providence next month.

The Bradbury-Stone Storage Battery Company, of Lowell, Mass., has received a proposition from a Western company to fit up a car with its system, with the understanding that if it works satisfactorily a line of 150 cars will be equipped.

The Worcester, Leicester and Spencer Electric Railway Company has been permitted to use the south side of Main street in Spencer. This removes the only obstacle to the right of way, and leaves the company at liberty to proceed to complete the road.

Notice of Removal.—The Robinson Radial Car Truck Company has removed to its new quarters, 180 Summer Street, Boston, Mass., opposite the New York & New England Railroad depot, offices Nos. 86 and 87, where its friends will always be made welcome. Mr. William Robinson is general manager of the company.

Mr. Frank Gilley read a paper before the Boston Electric Club last Thursday evening entitled "Electrical Bohemia" which proved very interesting and instructive, being an account of the speaker's experience and observations on a recent trip to London and Paris. Owing to bad weather but a small audience was present, and it seemed to be the unanimous opinion that it should be repeated at some future time.

The Massachusetts Electrical Engineers and Mechanics' Association held its first grand ball, at Odd Fellows' Hall, Thursday evening. The hall was beautifully decorated and great credit is due to Mr. N. Olsen and to Mr. Jas. E. Call for the taste and originality displayed in the arrangement of the lighting, the working of which was one of the leading features of the evening, the rapid turning off or on of the different series and colored lights frequently calling forth applause. The ball was a marked success, over 150 couples taking part. C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Jan. 31, 1891.

Mr. Chas. D. Jenney, of the Jenney Electric Motor Company, Indianapolis, Ind., was a welcome visitor in Chicago last week.

Mr. H. Jenkins, formerly with the Northwestern Construction Company and the National Engineering Bureau, will represent the Pond Engineering Company at Omaha, Neb.

World's Exposition Buildings.—Work was begun last Tuesday on the first building devoted to the World's Exposition. It was not an extensive beginning, consisting only in the placing of wooden stakes, which locate the boundaries of the administration building of the Construction department. It was originally intended that the building should be constructed of brick, and be two stories in height, but a wooden structure will be erected to serve the present needs, which consist mainly in providing a suitable storehouse for tools and instruments.

Storage Battery Cars for Tacoma, Wash.—The Point Defiance Railroad, at Tacoma, Wash., at present operated by Porter locomotives, will shortly be equipped by the River and Rail Electric Company, with its storage battery system. The road is about five miles long, and runs from the centre of the city northward to the smelting works, and has several long and heavy grades. It is also proposed to equip with storage batteries a road known as the Tacoma and Puyallup Railway, which is about 14 miles long. This road is now using a steam motor, which has met with strenuous objections on the part of the citizens.

The "Street Railway Review," a new publication, has issued its first number. This latest addition to the journals devoted to the interests of street railways presents itself as a candidate for favor with 100 pages of interesting matter, handsomely printed. Mr. H. H. Windsor, formerly secretary of the Chicago City Railway Company, has charge of the editorial department. Among the special articles may be mentioned "In Deepest London," being a description of the City and South London Railway; "The Largest Cable Road in the World," at Melbourne, Australia; and an illustrated description of the plant of the Broadway cable line in St. Louis. A handsome full page portrait of Mr. C. B. Holmes is also shown. The paper contains a very complete directory of street railways.

The Strike a Failure.—The strike of the telegraphers on the St. Paul road is over. The strikers have given up the fight and declared the contest off after having been out 14 days. This action was taken this week by the executive committee of the strikers. The main cause of the failure of the strike is said by the men to have been the non-fulfillment of promises made by some of the telegraphers. "We considered it our policy to declare the strike off," said Grand Chief Thurston. "We could have annoyed the company for some time to come, but we considered the possibility of winning or compelling concessions past. The cause of the failure of the strike was that a great many who signed the agreement did not tender their resignations." All operators employed by the "Soo" railroad have been offered the alternative of dismissal from the service of that company or withdrawal from the Order of Railway Telegraphers.

City Traction.—Chicago has long been hampered by the absence of proper facilities for rapid and adequate transportation, but now a number of electric roads are projected and several have already made preparations for the work of equipment, and two of the southwestern electric railway schemes which have been in a torpid condition for some time now show signs of life. On Ninety-fifth street the preliminary work of securing right of way and village ordinances has been completed, and two meetings of property owners were held last week in the interest of this road. The Calumet Electric Company asked that $50,000 be raised; $10,000 for each mile between State street and Crawford avenue, and a committee was appointed to make final arrangements in securing guarantees for the necessary amount from owners. The Chicago, Blue Island & Harvey Street Railway Company has secured two and one-half miles of right of way in the village of Blue Island. A line between Pullman and Burnside is to be built by the Calumet Electric Railway Company. This company will ask for a franchise on Ninety-fifth street, west from Michigan avenue and south on this thoroughfare to Pullman. The popularity of electric roads has been established and a number of new schemes are being planned. "We must have better facilities for transportation," said a prominent citizen who is interested in the West side. "Chicago may be the leading city in every other respect, but in transportation it is away behind the times. It is as slow as the coach of old days. The idea that people have to pack and jam into horse and cable cars and snail along home is becoming unendurable. We must have electric cars running in every direction, elevated cars in every direction, and swift trains in every direction, and plenty of them. There is no reason why a man should be compelled to wait a minute for a cable car, steam car, or electric railway in this great city. Why have these improvements been kept back when the city has prospered so wonderfully in every other direction? An electric road is being equipped on West Madison street now, and we will run cars every minute if necessary. As it is we have laid 12 miles of track on Madison and Lake streets, that will add 50 per cent. to the value of property along its lines, and 200 per cent. to all property around Oak Park, River Forest, and along the Desplaines River. The work on the West Madison street line has been delayed on account of a mistake in the construction of the cars. These cars are being built by the Pullman Company and are something out of the general order. They will be 20 feet in length, inside measure, and will be fitted with double trucks. They will be heated by stoves and lighted by electricity." H. C. E.

MINNEAPOLIS, Minn., Jan. 30, 1891.

Mankato, Minn., has its new arc lighting system in successful operation.

E. K. Tarbell, of Winona, Minn., has contracted with the Edison Company to put in a 600-light plant at the Hotel Winona.

The Lake Superior Electrical Contracting Company has been organized at Marquette, Mich., with a capital stock of $200,000.

At Eau Claire, Wis., the Electric Light and Power Company has received a new 500 h. p. compound condensing engine from the Russell Company of Massillon, Ohio.

At Hallock, Minn., the city council has granted the Northwest Thomson-Houston Company of St. Paul the franchise for lighting the city by electricity. A plant will be put in at once.

The Northern Car Company, of this city, is turning out some handsome motor cars for the Fida'go City & Anacortes Railway on the Pacific coast, and for the street railway company of Tacoma, Wash.

The Electric Street Railway Company, of Independence, Iowa, has been granted a 25-year franchise for the construction of an electric line on the principal streets of that city and to the state hospital for the insane. C. W. Williams heads the enterprise. The lines will be built this summer. The corporation is exempted from taxation for ten years.

One hundred thousand tons of iron, bought a year ago by the Minneapolis Street Railway Company for the construction of cable lines, is now being broken up and sold to local foundries for recasting. Since the adoption of the electric system the company has no use for cable material, and is forced to dispose of it in this way because there is absolutely no demand for cable material as such.

Nine million dollars' worth of the bonds of the Minneapolis and St. Paul street railway companies have just been negotiated. This places the companies in a situation that admits of the active prosecution of projected electrical lines. Some of these lines are important ones, notably that which is to connect the cities with Lake Minnetonka. It is rumored that J. J. Hill, president of the

Great Northern Railway line, has purchased large blocks of street railway stock within the past few weeks, with the view of assisting the development of electrical railways between the cities.

Michael Gohan has begun suit against the Western Union Company in the courts at St. Paul for $5,000 damages, based upon the failure of the company to deliver a telegram. No financial loss is claimed, but the plaintiff was unable to attend his brother's funeral through the alleged neglect.

A Bill has been introduced in the Minnesota Legislature providing that no passenger on a street car who is compelled to stand shall be required to pay fare when notified by the conductor before entering that the car is full. An amendment is proposed which will require the standing passenger to pay three cents. This bill is aimed at the corporation controlling the electric lines in Minneapolis, St. Paul and Duluth, which, in view of recent extensions and improvements, is just at this time unable to provide cars enough for complete equipment. A strong impression prevails that such a measure is out of place in a State legislature, and that municipal governments should act as they see fit in the premises. The bill, therefore, may not pass.

SOUTHERN NOTES.

NORFOLK, Va., Jan. 31, 1891.

Eutaw, S. C.—The Postal Telegraph Company has established an office at Eutaw.

Pulaski City, Va.—The Pulaski Electric Company is erecting an electric light plant.

San Marcos, Tex.—A movement is being made to establish an electric street railway.

Americus, Ga.—A telephone line is to be established between Americus and Ellaville.

Eastlake, Ala.—The Eastlake Electric Light Company's plant is to be considerably enlarged.

Bessemer, Ala.—A movement is on foot looking to the establishment of a telephone exchange.

Lake Charles, La.—The city council is obtaining estimates on the cost of an electric light plant.

Jefferson, Tex.—A $20,000 fire recently destroyed the Western Union Telegraph Company's buildings.

Macon, Ga.—An effort is being made to form a company to establish a telephone line between Macon and Forsythe.

Culberson, N. C.—An electric light plant will be established by the Nottia Consolidated Iron, Marble and Talc Company.

Temple, Tex.—The new electric light plant is finished and the lights have been turned on and are giving satisfaction.

Greenville, Ala.—It is stated that preparations are being made for the establishment of an electric fire alarm system.

Athens, Ga.—The foundations of the new electric light plant have been finished and work on the construction is in progress.

Bessemer, Ala.—The Bessemer Electric Company has called a meeting of stockholders for Feb. 2 to consider the issuance of bonds.

Abilene, Tex.—Two car loads of machinery and poles for the electric light plant have been received and work is progressing on the buildings.

Dallas, Tex.—The Oak Cliff Light and Power Company, with $50,000 capital stock, has been incorporated to establish an electric light plant at Oak Cliff.

Piedmont, West Va.—The engine house of the Pulaski Electric Light and Power Company was recently damaged by fire and will be repaired at once.

Union City, Tenn.—A bill has been introduced in the State Legislature empowering the Union City Water Company to establish an electric light plant.

Hampton, Va.—Work on the new electric road is progressing rapidly, and will probably be completed between Hampton and Mills Creek by the first of May.

Washington, Ga.—A company was recently organized to establish an electric light plant which has just been completed. It will operate an incandescent system.

Rosney, Va.—An electric light plant will be established by the Rosney Iron and Lumber Company, Limited, recently incorporated with a capital stock of $1,000,000.

Danville, Va.—The Electric Light Committee of the City Council is discussing the advisability of putting in an alternating incandescent electric light plant.

Rockville, Md.—The Edison Light Company, of Washington, D. C., is reported to have been awarded a contract for the erection of an electric light plant in Rockville.

Norfolk, Va.—The Western Light Company, of Chicago, Ill., has been awarded the contract, at $13,676, for the erection of an electric light plant in the Norfolk Navy Yard.

Raleigh, N. C.—A bill has been introduced in the North Carolina Legislature consolidating the Salem Electric Light Company and the Winston Electric Light and Power Company.

The Atlanta Street Railway Company has commenced work on its contemplated improvements. The company has adopted the overhead trolley system; the total cost will be $300,000.

Bristol, Tenn.—A company has been organized, with $100,000 capital stock, to establish an electric light and gas plant. A. H. Leftwich is president, R. C. Holley is vice-president and T. H. Fox is secretary.

Louisville, Ky.—A new electric light company has recently been formed to establish an electric light plant. Marcus Ruthenberg is president; W. S. Love is vice-president, and Herman Knirhm is secretary.

Waynesboro, Md.—A company has been formed to erect an electric light plant and to furnish light to business houses and private residences, but the city council will not allow it to erect poles or string wires overhead. Waynesboro is a town of 4,000 inhabitants.

Richmond, Va.—A joint meeting of the electric light ordinance and light committee of the city council was held recently to consider the petition and accompanying ordinance allowing the Traylor Electric Company the privilege of running wires for the purpose of supplying private consumers with electric light.

Atlanta, Ga.—At a recent meeting of the city council the electric light committee reported favorably on granting the Atlanta, West Point & McPherson Barracks Railway the right to occupy certain streets of that city, subject to the rules and regulations now governing street railways. Work is to commence May 1st and to be completed by July 1st.

Atlanta, Ga.—The Southern Bell Telephone and Telegraph Company has purchased a lot 70 × 121 feet, upon which an exchange building will be erected, the details for which, however, will not be arranged before the first of March. The building is to be a substantial and commodious one, equipped with all modern conveniences. All telephone wires are to be put under ground and the building will be erected with this in view. The site of the lot purchased was selected in view of the central location in the telephone system. The company paid $25,000 cash for the property. The plans for the building are now being prepared.

Augusta, Ga.—Quite an unusual ceremony was recently observed in the electric power house of the Augusta Street Railway. The power is furnished by water and the honor of turning the flood on was given over to the fair hands of Mrs. Dyer and Mrs. Jarvis, of Kansas City, Mo., wives of the principal promoters of the enterprise. There were present Mr. S. N. Jarvis, of the Jarvis-Conklin Company, of Kansas City, Mo.; Mrs. Jarvis, President and Mrs. Dyer, Engineer C. A. Maxwell, H. L. Purdy, inspector of the Edison General Electric Company; William Carroll, inspector of the Augusta Railway, and a number of others. When the hour for turning on the power arrived, the ladies mentioned above put their hands to the wheel, which they turned a few times till sufficient pressure was gained and the heavy wheels and belts began moving. In a few minutes sufficient speed was gained and ten incandescent lights in the wheel room were lighted up. Then the pop of a champagne cork was heard and the party drank to the success of the Augusta Electric Railway Company. The use of water instead of steam is giving much more satisfaction and saves thousands of dollars to the company. The officials of the company claim that this is the cheapest power in the United States, and that power that usually costs $90 in other cities of the country is obtained in Augusta for only $5. V. N. B.

WASHINGTON, D. C., Jan. 31, 1891.

The New Electric Line.—The Eckington and Soldiers' Home Electric Railroad Company will have its line in operation by the first of March. The company has made a contract with the Accumulator Company, of New York, for a storage battery equipment. In view of the fact that operating street cars by storage battery is practically an experiment, the officers of the Accumulator Company have backed their contract with a strong bond to operate the road for a period of three years, and if their cars are not what they represent them to be they are to be taken off the road and the railroad company will suffer no loss.

A Pacific Cable.—Senator Mitchell last week introduced a bill in the Senate incorporating the Pacific Cable Company, with a capital stock of $5,000,000, to operate a cable between San Francisco, Hawaii and Japan. The management of the system is to be vested in a board of directors, a majority of which must be citizens of the United States. The Secretary of the Treasury is authorized to pay to the company an annual subsidy of $200,000 a year for 15 years, and the usual provisions are made for election of officers and the general management of the affairs of the company. Representative Morrill introduced a similar bill in the House.

Electrical Conduits.—The District Commissioners recently assembled to consider the following section from the appropriation bill under the head of telegraph and telephone service: "That pending the action by Congress upon the report of the board to consider the location, arrangement and operation of electric wires in the District of Columbia, pursuant to the act approved Aug. 6, 1890, the Commissioners of the said District shall not permit the construction of any conduit or subway for electrical purposes in any street or avenue of the city of Washington or Georgetown." Mr. Samuel M. Bryan, representing the Chesapeake and Potomac Telephone Company, and A. A. Thomas, of the United States Electric Company, were present at this hearing. Both of these gentlemen have unused permits on hand and they claimed it would be unjust to revoke them. Mr. Bryan requested the Commissioners to submit some amendments to the section above quoted. This would put the section in a conference committee. Then the interested parties could appear before the committee and argue the case. The matter was taken under consideration by the Commissioners.

Electric Light Grants.—The Commissioners of the District of Columbia have granted the United States Electric Lighting Company permission to lay an underground conduit on certain streets of the city. The company is not to erect poles in any street or avenue. They are to be placed in alleys in such positions as not to interfere with the free use of the same. The commissioners inserted a stipulating clause in the permit to the effect that the permit granted to the company is in no way to relieve the United States Electric Lighting Company from a full and complete compliance with any and all acts of Congress hereafter passed in issuance of the recommendation of the board of three persons authorized by the appropriation act of Aug. 6, 1890, for the District of Columbia to consider location, arrangement and operation of electric light wires in the District. It is further stipulated that all overhead electric light wires of the company along the route specified shall be removed within 60 days from the time of completion of the conduit, and that all work be done at the sole risk and expense of the company under the direction and suggestion of the requirements of the engineer department of the District.

Damage to Electric Wires.—The storm of Saturday night was more destructive to the telegraph wires throughout this part of the country than the great blizzard of 1888. The rain and sleet striking on the wires froze there in such a manner as to offer but small resistance to the wind, and as a result long stretches of wire were blown down, carrying the telegraph poles with them. A large number of local wires were blown down, as well as those beyond the city in Virginia and further south. It is reported that over a thousand wires had fallen between Washington and West Virginia. The city was largely cut off from telegraphic communication, and messages had to be delivered in a roundabout way. Manager Marean of the Western Union Telegraph Company, upon being asked whether a few more damaging storms like this would not induce the telegraph companies to adopt some method of running wires that would be a little more permanent, replied: "I hardly think so; not at any rate for long distances. Any underground or conduit system would be too expensive. Why, it would cost as much to lay an underground cable as it would an Atlantic cable, with a resulting tariff of charges necessarily so high that it would put a stop to the general use of the telegraph as a means of communication." E. A. O.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Motor Design.—Will you please tell me the size of an electric motor to receive a current of five volts, giving the number of pounds of iron in the armature and fields, and number and feet and size of wire required to wind each, with speed? A. B.

We print this for the purpose of calling the attention of our correspondent to the brief paragraph at the head of this column, which he has perhaps not noticed. We must simply refuse point blank to do motor or dynamo designing in this column, as it would result in our being overburdened with that class of work. As it is, numerous similar inquiries have to be thrown into the waste basket every week. This column is intended to give to our readers information that is of general electrical interest, and we wish that on their part they would note carefully the paragraph which heads it, as it will save them disappointment and us needless waste of time.

Low Voltage Lamps.—Will you please answer the following questions? (1) What is the price of Fleming's "Short Lectures to Electrical Artisans"? (2) If I wish to run twelve 16 c. p. incandescent lamps, each of 20 volts, what voltage current should I use? AMATEUR.

(1) $1.50. (2) Run your lamps in parallel and use a 20-volt current.

Incandescent Lamps in Series.—Can I run 50 c. p. incandescent lamps in series with 32 c. p. 50 volt lamps, provided I use a higher voltage, and what should it be? T. M. D.

If the two lamps take the same amount of voltage, which they probably do not, you could run them in series perfectly well by supplying the same voltage required for the two lamps separately. If they do not require the same current you may be able to operate by running two 32 c. p. lamps in parallel with each other and in series with the 50 c. p. lamps.

Distribution of Time by Electricity.—(1) I would like to know if there is such a thing as a machine for sending time over a telegraph line? (2) If not, would an instrument to send the time from a certain point in 15 or 20 different directions over as many lines be worth anything? J. E. B.

(1) There are several elaborate arrangements for sending time over telegraph lines with the greatest exactness. (2) Probably not, on account of the very limited field and the apparatus already in use.

Chromic Acid as a Depolarizer.—Will you please inform me through your columns if chromic acid put in the porous cup of a Leclanché battery will reduce polarization, and if hydrochloric acid in the fluids strengthens the current? K. M. I.

Chromic acid is an excellent depolarizer, but it is unfitted for open circuit work, and should not be put in the porous cup of the Leclanché battery. Hydrochloric acid in the fluid would temporarily strengthen the current, but with damage to the life of the battery, and should not be used.

Chloride of Silver Cells.—W. E. P.: (1) A satisfactory Gramme armature can be made of a piece of soft iron pipe as you suggest. (2) The chloride of silver cell, in order to give satisfaction, must be made with considerable care. This cell is the most expensive to make, and is by no means the best, except for certain uses demanding a standard element, and we would advise you to use some other form if you desire a cell for general use. Following are the directions for constructing the chloride of silver cell of De la Rue the form mostly used for laboratory purposes: In a solution of chloride of ammonium C P (sal ammoniac, chemically pure) 403 grains to one quart of water, or 1 part in 40, is suspended as the negative electrode a cast rod of chemically pure zinc, and as the positive electrode a cylinder of chloride of silver containing a fine core of cast silver. The cell should be sealed with a stopper of paraffine wax, and is usually about six inches long and one inch in diameter, and has an internal resistance of 3 to 4 ohms. A new cell must be short-circuited at the beginning, for about fifteen minutes. (3) Hering's "Dynamo-Electric Machinery" is one of the best works of the kind you desire.

Permanent Magnets.—I wish to fully charge some permanent horseshoe magnets. I can find no one hereabouts who can give me much information on the subject. I can have the use of the dynamos in a railway power house for supplying the requisite current. I made magnets of tool steel and hardened them, and I am unable to more than partially charge them. Will you be kind enough to give me some information on the subject? What kind of steel shall I use, and how shall I manipulate it? G. P. R.

Tungsten steel annealed makes very superior permanent magnets. In the absence of this you had better use Stubb's steel tempered very hard indeed. Put as many turns of heavy wire around the magnet as its size will permit, and pass all the current you can get through it. To ensure permanence the following process is often recommended. After magnetizing your magnets keep them at the temperature of boiling water for 24 hours; you will find that they have weakened some; remagnetize them and boil them again; by the third or fourth magnetization the steel will have worked itself into a steady magnetic state, and the result should be a very good and permanent magnet. You will probably find that the railway currents will do the work successfully, and you might as well keep the magnets in circuit an hour or two, or more if convenient.

Queries Regarding Electrical Railways.—Will you please answer the following questions: (1) Why are large railway generators so susceptible to lightning? (2) Could the earth be safely used as a return conductor for a heavy current between two towns in which there are no water pipes or gas mains? (3) Why do the fuses on an electric car burn out when both rails are submerged in water? (4) Would a heavy current cause any harmful conduction when the wires are strung close to telegraph wires? L. B. S.

(1) Railway generators are especially susceptible to lightning for two reasons: First, because they are high potential machines, and consequently make the most of any short circuit that occurs; and, second, because being shunt wound the enormous self-induction of the field magnets forces any lightning that reaches the machine through the armature, generally resulting in piercing the insulation between the coils and the core, or between two adjacent coils, when the short circuit produced promptly burns out the machine. Series wound machines are, in a large measure, protected by the high self-induction of the magnet coils. (2) Not to advantage. (3) They do not burn out because both rails are submerged in water, but because the water is apt to spatter, and thus reach the most vital parts of the machine and produce a short circuit. (4) No, unless in a very extreme case. A short circuit or a sudden demand for a very heavy current on the railway line might interfere with the telegraph lines, but in ordinary working there would be no likelihood of trouble. Keep away from telephone lines, however.

Galvanometers with Tilting Coils.—Please answer the following inquiries: If a standard Clark cell be made to send a current through a coil of wire in the centre of which is hung a compass needle and another coil be made to act on the needle, the last coil surrounding the first, and being made so that it may be turned on a horizontal axis which is parallel with the plane of the first coil and if extended would pass through the centre of the needle, and if an unknown current be passed through the second coil which is turned down until its effect on the needle is just balanced by the first coil and its current, what will be the relative strength of the two currents, providing each coil has an equal number of convolutions of wire? That is, will the current in the second coil stand related to the current in the first coil according to the tangent, sine, or secant of the angle to which the first coil has been turned? C. W. W.

The arrangement of tilting coil you mention is used in what is known as the Obach galvanometer, which, however, has no

stationary vertical coils. In this instrument the strength of the currents circulating in the ring are directly proportional to the tangents of the angles of deflection of the needle, multiplied by the respective secants of the angles of inclination of the ring; in other words, a current equal to tangent *A* multiplied by secant *B*, multiplied by a constant depending on the dimensions of the ring. If used in the way you suggest, that is, to oppose a known current flowing in a vertical coil, the constants of the coils would not be the same unless great care was taken in winding them, and in any case the relation between the effects of the two would not be a simple or convenient one. Further, the Clark cell cannot be used on closed circuit work with any degree of success.

News of the Week.

THE TELEGRAPH.

San Antonio, Tex.—The Western Union Telegraph Company will immediately begin the construction of a line from San Antonio to Corpus Christi, Tex. The object is to handle more promptly all of the coast business, which now goes by way of Houston. San Antonio will be made the relay point for all coast business, which will increase the force here.

THE TELEPHONE.

Logan City, Utah.—The city council has passed an ordinance granting a franchise to the Rocky Mountain Bell Telephone Company.

Houston, Tex.—A telephone line from San Antonio to Houston, Galveston and Corpus Christi is on foot and will be put in in a short time. It will be a great convenience and should pay well.

Elkton, Md.—The new telephone company opened an exchange in the building next to the post office at Elkton last week. The exchange has a fine new switchboard. The company now communicates with Port Deposit, Rising Sun and Colora, and expects to add North East, Chesapeake City and Cherry Hill soon.

Newbury, Mass.—The New England Telephone Company built last year new trunk lines, metallic circuit, to Fitchburg, Haverhill, Gloucester and other points; also extended and improved the service out of Portland, Me., put in a new line between Pittsfield and North Adams, and did, beside, a great deal of new underground work in Boston. Its metallic circuit work for the year has cost full $200,000. The business of the company has shown a steady improvement during the year, despite the electrical difficulties that it has to contend with, and its annual report will make an exceptionally good showing.

Telephone-Phonograph Experiment.—An experiment in long-distance telephoning in combination with the phonograph took place in Orange, N. J., recently. James B. Dill, the legal adviser of the New York and New Jersey Telephone Company, connected the long-distance telephone in his house with the transmitter of his phonograph, and through the Central station was connected with Trenton, Philadelphia, New York, Jersey City, Yonkers, and finally with Boston. A large number of phonographic cylinders were reproduced and the reports from all the stations were that the records were received with perfect clearness, except in the case of Boston, where the circuit was frequently broken on account of the pressure of commercial business. There were a large number of electrical experts present in the various offices that were thus connected, and the experiment was pronounced a complete success.

THE ELECTRIC LIGHT.

Leslie, Mich., is to have electric street lighting.

Memphis, Tenn., will have its lights in a few weeks.

Columbus, O., calls for proposals for a municipal plant.

Ripon, Wis., will be lighted by electricity, beginning Feb. 15.

Berlin, Wis., expects to have its electric plant completed this week.

Warsaw, N. Y., will soon begin work on its electric light plant.

Oxford, Mich., now has its streets lighted with the Heisler system.

Sturgeon Bay, Wis., has contracted for electric lighting at $1,000 a year.

Harlan, Ia.—The citizens of Harlan have voted for electric lights and water-works.

Tuscola, Ill.—The Newman Electric Light Company now has its plant ready for operation.

Green Bay, Wis.—A franchise has been granted to Mr. W. O. Stone to establish the new electric light plant.

Indianapolis, Ind.—The Central Thomson-Houston Company is installing a 150-light plant for Baker & Randolph.

Lampasas, Tex.—The contract for putting in the electric light plant has been let to be completed within sixty days.

Edinburgh, Ill., will have electric lights in a few months. Preparations are being made to have the plant in operation by March 1.

Anderson, Ind.—The Central Thomson-Houston Company is installing a plant of 200 lights capacity in the works of the American Wire Nail Company.

The Green Bay (Wis.) Electric Light, Power and Heating Company is pushing ahead its extensive works. All the machinery has been ordered.

Washington, D. C.—The Lighthouse Board in its report issued last week recommended an appropriation of $25,000 for lights at Big Oyster Beds, Delaware.

The Dyersburg (Tenn.) Water and Electric Light Company has received a large dynamo, and when put in position will add much to the lighting of the city.

The Stroudsburg (Pa.) Electric Light Company will extend its service to East Stroudsburg. To accomplish this its capital has been increased from $15,000 to $30,000.

Provo City, Utah.—The National Electric Manufacturing Company has just finished installing a 500-light alternating current plant for the Payson Electric Light and Power Company.

Wires in France.—A large contract for wire has been awarded to the Standard Underground Cable Company of this city by the French government, which intends putting all its wires underground.

Raton, N. M.—The new electric light plant has been completed and is giving the best satisfaction. The wire is soon to be extended the whole length of Rio Grande avenue and possibly on ome other streets.

The Chattanooga (Tenn.) Electric Light Company is now ready to wire and light the new county bridge over the Tennessee River. The officials of the company state they will have it lighted by the time it is turned over to the county.

Janesville, Wis.—Steps have been taken which assure the establishment of an incandescent electric light plant in that city in addition to the arc plant which now lights the business part of the town. The plant will be put in by H. A. Doty, of Janesville, and will be the Edison system.

Omaha, Neb.—The electric light company has put in a new compound 125 h. p. engine and a new 750-light dynamo. The latter improvement gives the plant a total of 1,500 incandescent and 65 arc lights. A new 100 h. p. boiler will be put in. The company is moving into the new quarters recently erected.

New Works.—Several gentlemen interested in the locating of large electric works visited Baltimore last week and examined a number of eligible sites. The party was composed of New York and New England capitalists, and they were favorably impressed with that city because of cheap fuel, abundance of labor and railroad facilities. A company has already been formed with a capital of $500,000 fully subscribed.

THE ELECTRIC RAILWAY.

Raleigh, N. C.—Work on the electric street railway progresses rapidly.

Angola, N. Y.—A contract has been let by the Jamestown Street Railway Company for its line to Lakewood.

Burlington, N. C.—It is proposed to run electric cars between Burlington and Graham, the county seat of Alamance.

Jersey City, N. J.—The proposed railroad station to be located at the foot of Armstrong Place will be erected early in the spring.

Baltimore, Md.—The Union Passenger Railway Company has at last fallen into line, and has asked the city for permission to put overhead wires along its lines for electric motive power.

Naples and Capo di Monte Railway.—A London firm of engineers has received a concession for the building of an electric railway, five miles in length, between Naples and Capo di Monte. The work must be finished within nine months.

Tacoma, Wash.—The new 1,000 h. p. engine to drive the cable machinery and power for the new electric lines of the Tacoma Railway and Motor Company has arrived from New York. Owing to its great weight it had to be loaded on five cars.

Brooklyn, N. Y.—William E. Rogers, chairman; Isaac V. Baker, Jr., and Michael Ricard, constituting the State Railroad Commission, held an adjourned hearing in the Chamber of Commerce last week relative to the application of the Jamaica & Brooklyn Road Company to be permitted to use electricity as a motive power on the road. The road has been using the trolley system of overhead wires for about two years, and action was brought by the authorities of Jamaica and Brooklyn in order that certain local restrictions might be imposed on the management of the road. Representatives appeared from Jamaica but none from Brooklyn. Edward S. Clinch appeared as counsel of the Jamaica & Brooklyn Road Company and at the hearing the matter was settled satisfactorily.

The Seattle (Wash.) Electric Railway and Power Company's stock is to be transferred to Eastern capitalists. Articles of incorporation have been filed by a new corporation to which the property of the old company was transferred, and which has a capital stock of $1,500,000, divided into 1,500 shares of $1,000 each. This new company takes the name of the Seattle Consolidated Street Railway Company, and the incorporators are F. T. Blunck, of Davenport, Ia.; D. T. Denny, George Kinnear, G. K. Carter, J. E. Porter, Rebecca M. Kinnear, J. F. Hale, V. Hugo Smith, L. H. Griffith, E. C. Kilbourne, J. Furth, A. Dunne, George E. Miller, L. D. Ross, F. M. Griffith. At a meeting held recently the company was temporarily organized by the election of the following trustees, who will manage its affairs until the second Monday in April: D. T. Denny, J. F. Hale, E. C. Kilbourne, L. H. Griffith, George Kinnear, V. Hugo Smith and J. E. Porter. The majority of the stock still remains in the hands of the Seattle stockholders, so that they will retain control of the property.

Baltimore, Md.—From the present outlook it seems as if Baltimore was beginning to reap beneficial results from the efforts to call attention to the advantages of the city as a manufacturing centre. A party of New Yorkers have been here investigating the merits of the Smith patent boiler, with a view of becoming financially interested. At present the Smith company is organized, but has its boilers made at different shops. In the event of the negotiations now in progress being successful, the company will erect works and add another industry to the city. The New Yorkers interested in the new electrical plant to be established in this city were engaged in examining sites offered at Locust Point and the Eastern branch. Thursday they will visit Sparrow's Point. The work will be commenced as soon as the location is settled and the company incorporated. The plant will cover a big lot of ground and the works will be second to none. It will be a branch of an enterprise already established, which possesses all the most improved appliances.

LEGAL NOTES.

The Central District and Printing Telegraph Company commenced suit at Warren, Pa., on Jan. 24, against the Warren Electric Light and Power Company to recover damages for the induction of the electric light wires. The telephone people also ask the light company to change its wires, or if the removal will not prove a remedy, to allow plaintiffs a perpetual injunction.

Decision in the Boston Suburban Light Company's Cases.—In the Supreme Court of Massachusetts in Boston, last week, a decision was handed down in the cases of the Suburban Light and Power Company vs. Board of Aldermen of Boston. Both petitions are substantially alike, in which the court was asked to order the aldermen to give the petitioner a writing or writings specifying where in the highways and public streets of Boston the petitioner might erect posts to enable it to perform the contract alleged to have been made with the city for lighting certain of its streets. It will be remembered that this case grew out of the refusal of the aldermen to grant pole rights to the petitioner after the mayor had given notice, in December, 1889, that the contract for lighting the public streets in 1890 had been awarded to the Suburban Light and Power Company. The company then sought the aid of the courts to compel the granting of the required rights. In both cases the court dismisses the petition and refuses to compel the aldermen to comply to the company's request.

The McKeesport Light Company.—A bill in equity was filed Jan. 26 by the Edison General Electric Company, the Edison Light Company, Samuel Insull, Thos. Petty and F. H. Busch against the McKeesport Light Company, Thos. L. White, president and director, and Thos. Reynolds, Jas. E. White, Henry Reiber and James S. Kuhn, acting directors of the McKeesport Light Company. The plaintiffs, it is asserted, own 1,065 shares of the 1,843 shares of stock issued by the McKeesport company. At the annual meeting, Oct. 11, 1890, an amendment to the by-laws was passed increasing the number of directors from five to seven. The minority stockholders obstructed the business of the meeting, preventing an election. A call for a special meeting was refused, and an application was then made to the court for a mandamus on the president to call a special meeting. The mandamus was refused, but the opinion of the judge was in favor of the plaintiffs. On the strength of the opinion, White called a special meeting. The plaintiffs were present, but only 41 shares of the minority stock was represented. This left the meeting without a quorum of two-thirds of the stock, and Mr. White declared an election could not be held. The plaintiffs say that, though they have a lawful right to the control of the company, they are not represented on the board of directors, and have no share in the management. They ask that a receiver be appointed to look after the business, and that the defendants be restrained from exercising the functions of officers or interfering in any wise with the progress of business.

PERSONALS.

Mr. Wilfrid H. Fleming, who was recently in charge of the advertising business of the Edison Company, has now assumed the management of the electrical advertising department of the *American Exporter*, a journal which publishes a Spanish edition for export to Central and South America.

Mr. Robert S. Ashe, one of the electrical engineers of the Edison Company, was in the city last week. He has recently been engaged upon construction work at Amsterdam, N. Y., where an Edison electric railway has just been put in operation. This line, Mr. Ashe says, has a grade officially reported to be 13½ per cent. and about 2,000 feet long. The entire equipment is in first-class working order, and not a schedule trip has been missed since the opening of the line, six weeks ago.

Californians in the East.—Mr. E. P. Clarke, of Los Angeles, Cal., and Mr. P. Noble, of San Francisco, spent last week in Pittsburgh. The gentlemen are interested in a large electric railway system for Los Angeles, and are making a tour of the East with a view to deciding the kind of apparatus to adopt for their work. While in Pittsburgh they paid a visit to the shops of the Westinghouse Company, and also took occasion to observe the several electric roads in operation about the city.

Industrial and Trade Notes.

The Celluloid Novelty Company, of 313 Broadway, this city, manufacturers of a line of celluloid electrical fittings, has changed the firm name to the Celluloid Company, and is about to remove to 427 and 429 Broadway.

Messrs. J. Jones & Son, of New York, manufacturers and dealers in electrical apparatus and special machinery, have bought out the plant of the late firm of Clapin & Thompson, and are to carry on a general electrical manufacturing business.

The Berlin Iron Bridge Company, of East Berlin, Conn., is now building, from its own designs, the new smelter of the New Jersey Zinc and Iron Company, at Newark, N. J. The building is 25 feet wide by 216 feet long, and entirely fireproof.

Messrs. Wetherell & Carpenter, paper manufacturers, at Newington Center, Conn., are furnishing the Thomson-Houston Electric Company with a card board paper, which is used in building armatures. They are shipping considerable quantities of this material.

Mr. Manual A. Vaslier, chief of the telegraph department, Western Railway, Havana, Cuba, has had excellent success with the Edison-Lalande battery, and expects to adopt it in replacing the old type of gravity battery now in use on the telegraph lines of which he is the superintendent.

Messrs. Himmer and Anderson, the well known manufacturers of dry batteries, have just introduced to the trade a new "Jumbo" cell which shows an E. M. F. of one and eight-tenths volts and a current capacity of sixteen ampères. This cell is especially adapted for gas lighting purposes.

The C. McIntire Company, Newark, N. J., received orders during three days of last week for over 23,000 of the McIntire patent connectors, to be used in electric light, railway, telegraph and telephone construction work. A better endorsement of this well known connector could hardly be desired.

The Findlay Glass and Carbon Company, of Peru, Ind., and St. Louis, Mo., sent us the following letter in reference to the rumors recently circulated concerning the affairs of that company: "The reports that have been out as to our finances are untrue. We are in first-class shape, having responsibility of, say, $300,000."

The American Steam Packing Company, of Boston, has issued a neat circular describing its anti-friction packing, well known to all steam users. The company makes a specialty of preparing the packing for every form of duty, and engineers in charge of electric light stations can secure a sample by sending their address.

Mr. George A. Washburn, of the firm of Ford & Washburn, at Cleveland, O., manufacturers of dynamos and motors and general electrical appliances, has recently brought out a novel form of storage battery cell, for which is claimed high efficiency with minimum weight and liability to buckling. This cell weighs 33 to 50 per cent. less than the usual cell for the same capacity. It is said that on a comparative test this cell showed its ampère hours to be nearly double that of some well-known makes.

The Acme Specialty Company, dealers in automatic appliances and electrical novelties, has opened offices at 78 Cortlandt street. J. J. Sleeper, M. D., is president and J. W. Barnes, secretary and treasurer. One of the first novelties that they have placed on the market is the "Acme" electro-medical machine, which is light and portable, simple in construction and easy to operate, giving three currents, the primary, secondary, and primary and secondary combined. This machine sells for $5.

The Eastern Electrical Supply and Construction Company has on the market the Happoldt cut-out, useful for protecting electric gas lighting batteries. It cuts the battery out of the circuit when a ground or short circuit occurs, thereby saving the expense of renewal. It should pay for itself in a short time in the saving of battery alone, besides placing the gas lighting under the control of the consumer. The Eastern Electrical Supply and Construction Company are the exclusive agents.

The G. T. Woods Manufacturing Company, of this city, has placed upon the market a line of novel electrical and mechanical appliances including "Indicator Cutouts," for the protection of dynamo and motor armatures against excessive currents, "Quick

Break," "Station Switches,' "Mainline, "Paralyzers, etc. Mr. Woods is the inventor of all the devices named above as well as some others. He has recently accepted the position of Professor of Mechanic Arts and Natural Science in the Virginia Seminary at Lynchburg, Va.

The Energy Manufacturing Company, 1115 to 1123 South Fifteenth street, Philadelphia, Pa., has issued a modified price-list of its improved patent hoisting machines, some of which are specially designed for use in electrical light stations. This company also manufactures a special drill guide and steady rest for use when drilling holes in lathe work; also a friction driven centre grinder, which enables the workman to secure an absolutely true centre with no delay or inconvenience. The company also manufactures other machinery of interest to electricians.

Mr. La Fayette Cole, traveling representative for Holmes, Booth & Haydens, New York, has just returned from a successful trip through the far West, during which time he secured some large orders in Salt Lake City, Denver, St. Louis and other points. Mr. Cole speaks enthusiastically of the bright outlook in electric railway construction work, and mentions several contracts that will probably be closed within a short time, and which will necessitate the expenditure of over half a million of dollars for apparatus and material, all of which is very encouraging to manufacturers.

The D. M. Steward Manufacturing Company, of Chattanooga, Tenn., is crowded with orders for its lava insulators, although it has a capacity for turning out nearly 50,000 of these insulators per week. One of the large electrical companies is now ordering its special form of insulators in lots of 50 000, and many of the manufacturing companies are having all work of this character done in lava. The Steward Company have just completed a trolley line insulator, which is said to be the strongest ever made. Recent tests made of the resistance of the Steward lava are said to have shown that it has a resistance of 50 megohms. It was also tested by heating nearly to incandescence and then plunging into cold water. It stood this remarkable test, it is said without developing the slightest perceptible crack, and the Steward Company is now preparing tubes of this material in various lengths and diameters, which are said to be cheaper than rubber or fibre.

Messrs. Taylor & Son, 39 Dey street, New York, are offering to the trade a battery cell of new design, the inventor of which is Mr. Theo. F. Taylor, a well known electrician. The cell is made of selected materials, with every possible precaution against deterioration. The zincs are so arranged that all of the zinc is immersed in a solution of 15 parts water to one of sulphuric acid, thus saving, it is claimed, 30 per cent. in the outlay for zincs. No bichromates are used in the solution. Their No. 1 cell is said to have an internal resistance of but .08 ohms and the current is 25 ampères on short circuit. The No. 2 cell will give a current of 8 ampères on short circuit and has a very small resistance. This company is also introducing a new depolarizing solution intended to replace nitric acid, which has been the most powerful depolarizing agent used in battery cells; unlike nitric acid, this solution will not stain the hands. One pint of this solution is claimed to be good for 70 ampère hours. This depolarizer is also prepared in the form of a powder, and can be sent by mail. As the cost of renewing the Taylor battery is only six cents it ought to jump into popular favor immediately.

MISCELLANEOUS NOTES.

Prof. Elihu Thomson gave a lecture last week at the Franklin Institute in Philadelphia on "Induction."

Mr. N. B. Brooks, of the Piqua (O.) Edison Illuminating Company, reports that he has had great success with transformers connected on the three-wire plan, such as described by A. L. Pierce in THE ELECTRICAL WORLD of Jan. 10. Mr. Brooks has also operated lamps on the three-wire system from one transformer having two secondary coils properly connected.

Sydney, N. S. W.—A great deal of interest is being manifested in the electrical business lately. All the principal suburbs have under consideration the question of electrical lighting, and in the first week of the new year the city council opened the question of lighting Sydney. The present price being charged for gas is 5s. 3d. per thousand feet: The Russell Place electric station, Melbourne, was burned down a few weeks ago.

Business Notice.

PEORIA, ILL., July 24, 1890.

Messrs. F. Meyer & Bro., Peoria, Ill.

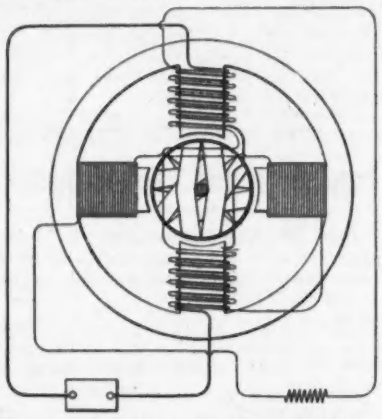
DEAR SIRS.—The Shultz pulley cover we bought of you does all that was claimed for it. We have had no trouble with belt slipping on our dynamo since it was put on. It is a great power saver.

Yours truly, TRANSCRIPT PUBLISHING CO.,
WM. BLOOMER, Supt.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS

U. S. PATENTS ISSUED JAN. 27, 1891.

445,176. Electric-Arc Lamp; Joel A. Haves, of Carson City, Nev. Application filed April 23, 1890. In an electric arc lamp, means for bringing the carbons together upon closing the circuit, consisting of a magnet in said circuit, an armature therefor, a secondary armature pivoted upon the first named armature and carrying a pawl, a ratchet wheel into which said pawl is engaged and mounted upon an arbor provided with a beveled gear-wheel,

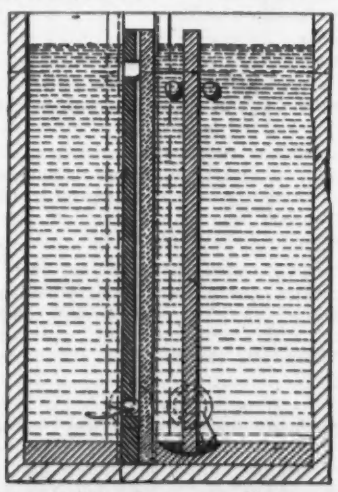


NO. 445,207.—ELECTROMAGNETIC MOTOR.

and a vertical shaft geared to the upper and lower carbons in the manner and for the purpose described and geared to said beveled gear-wheel.

445,207. Electromagnetic Motor; Nikola Tesla, of New York, assignor to the Tesla Electric Company, of same place. Application filed May 20, 1889. The combination, in a motor, of a primary energizing circuit adapted to be connected with the circuit of a generator and a secondary energizing circuit in inductive relation thereto, the two circuits being of different electrical character or resistance. (See illustration.)

445,217. Thermal Cut-Out; Albert Barrett, of Kansas City Mo. Application filed Dec. 5, 1890. The invention comprises an attenuated and relatively fragile portion of the circuit, a strong spring or an equivalent device capable under certain conditions of exerting a strong and sudden force upon the said fragile portion and thus causing a wide gap in the continuity of said circuit, a normal support for the said spring, whereby the said fragile section is ordinarily freed from the tension thereof, and means, comprising a ball or mass of matter, solid and hard, ordinarily, but capable of fusing under a moderate degree of heat, and a



NO. 445,425.—GALVANIC BATTERY.

heat concentrating coil of the said attenuated conductor closely associated therewith, for enabling the said spring to come promptly and forcibly into action and to break or tear away the said fragile conducting section to open the circuit.

445,234. Electric Cable; John C. Reilly, of Brooklyn, N. Y. Application filed May 20, 1890. The method of constructing electric cables, which consists in insulating a series of conductors, arranging them in concentric rows, applying a suitable sheathing, dividing them into a series of longitudinal sections, arbitrarily designating the terminals of each conductor of each section in regular succession with consecutive numerals, and then connecting each conductor of one section to a conductor of the next succeeding section by a formula.

445,295. Electric Bell; John F. Wollensak, of Chicago, Ill. Application filed Sept. 23, 1890. In an electric bell, the combination of a supporting frame, an armature and independently adjustable magnet spools, movable toward or away from the armature.

445,306. Circuit-Controller and Alarm; Charles M. Woolcott and Albert E. Wilmot, of New York, Assignors to Thomas W. Robertson and Charles E. Ongley, both of same place. A circuit-controller of a conducting material, which is dissolved or softened by water, in combination with circuit-terminals electrically connected thereby.

445,310. Electric Switch; George Cutter and Charles Goold Armstring, of Chicago, Ill. Application filed July 31, 1890. The invention comprises a plate of insulating material, a stationary post projecting therefrom, having its inner portion cylindrical and its outer portion square in cross section, a rectangular shunt block revoluble on the cylindrical part of said post, having two side edges thereof insulated, a boss integrant and concentric with said shunt-block, having teeth and spring brushes, in combination with a non-revoluble counterpart on the square part of said post, also having teeth and a push button.

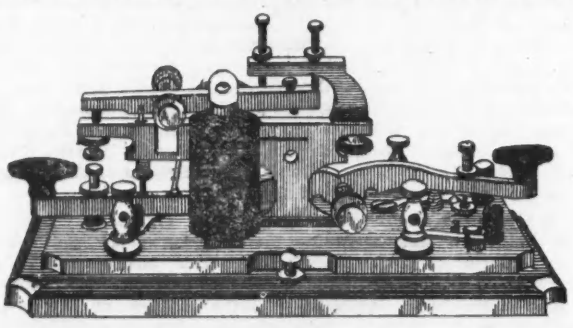
445,362. Cut-Out; Sigmund Bergmann, of New York. Application filed Jan. 25, 1890. In a cut-out, the combination of a frame having tubular portions adapted to connect with a tubing, a rotary shaft, a cut-out wheel loosely mounted on said shaft, contact plates on the wheel, and resilient contact pieces having tubular shanks secured in the tubular portions of the frame and insulated therefrom.

445,363. Electric Cut-Out; Sigmund Bergmann, of New York. Application filed Feb. 17, 1890. The invention consists in a pendant or other fixture, tube or arm having a seat adapted to receive a cut-out and a cut-out removably secured in said seat.

445,364. Key for Electric Cut-Outs; Sigmund Bergmann, of New York. In a cut-out, the combination, with a rotary shaft having channels and a reduced portion at its end, and spring-arms, of a tubular attaching-piece having an enlarged inner portion to engage over a section of the main portion of the shaft and the smaller in portion to engage over the outer portion of the shaft, and perforations to engage lugs on the spring-arms.

445,365. Electric Cable Connector; Sigmund Bergmann, of New York. Application filed July 24, 1890. The combination, with electric cable or conductor sections abutted end to end, of a longitudinally tapering strip wound around the end portions of the sections, with its wider end innermost and fastened in place thereon.

445,374. Manufacture of Carbon Filaments; William M. B. Keen and William F. Haarmann, of New York, Assignors of one-fourth to Egbert Le Fevre, of same place. Application filed June 19, 1890. The process of manufacturing carbon filaments for incandescent electric lamps, consisting in saturating a ligature of vegetable or animal fibre, such as cellulose or silk, with a mixture of hops and a solution of saccharine matter and glue, concentrat-



NO. 445,442.—TELEGRAPH KEY.

ing said mixture by boiling, drying the saturated material and carbonizing said ligatures.

445,409. Turn-Out for Electric Railways; Rudolph M. Hunter, of Philadelphia, Pa., Assignor by mesne assignments to the Thomson-Houston Electric Company, of Boston, Mass. Application filed June 29, 1887. In a current-collecting trolley the combination of supporting wheels to run upon the line conductor, a supporting frame having a connection for the collecting conductor, and a horizontal and laterally movable guard wheel normally out of contact with the line conductor and adapted to project under the line conductor and prevent abnormal upward movement of the collecting wheels.

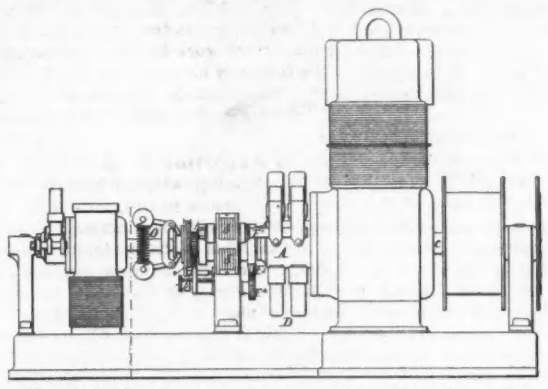
445,422. Secondary Battery; Charles F. Brush, of Cleveland, O., Assignor to the Brush Electric Company, of same place. Application filed June 9, 1881. The method of making a secondary battery element consisting in producing on a suitable body, frame, or support a coating or filling of electrically deposited spongy lead, then immersing the frame or support thus coated in a battery fluid in which said coating is insoluble, and peroxiding the coating by electrical action.

445,425. Galvanic Battery; Walter Ambus Crowdus, of Memphis, Tenn., Assignor to J. W. Allison, Trustee, of same place. Application filed Oct. 7, 1890. In an electric battery, the combination with a battery jar and a non-conducting porous partition dividing it into two chambers for the respective electrolytes of a conducting porous partition arranged against and cooperating with the non-conducting partition, whereby the thickness and resistance of the latter may be reduced without increasing the osmotic mixing of the electrolytes. (See illustration.)

445,442. Telegraph Key; John Doggett, of Plain City, O. Application filed July 28, 1890. In a telegraph key, the combination, with a sounding arm, a support for the same, and a pivoted key lever, having arms extending at each side of its fulcrum, of pivoted rods depending from each side of the pivot of the sounding arm and terminating below one of the arms of the key lever and a pivoted switch located between said arms and adapted to engage and rigidly connect either one of said rods with the key lever. (See illustration.)

445,448. Regulator for Dynamo-Electric Machines; John H. Holmes, of Newcastle-on-Tyne, England. Application filed May 14, 1890. In electric machinery for lighting railway trains, a generating dynamo the field magnets of which have, in addition to the ordinary shunt wound exciting circuit, a supplemental circuit connected to an independent source of current, and having in series with it the armature-circuit of a regulating dynamo driven at the same speed or subject to the same degree of speed variation as the generating dynamo, the electromotive force of the regulating armature being made to oppose the electromotive force of the independent source of current, so that its variation in proportion to the variation of speed will practically maintain constant the electromotive force of the dynamo. (See illustration.)

445,475. Telephone; Eloy Noriega, of Mexico, Mex. Application filed Oct 2, 1890. The invention consists in a transmitter provided with a wooden diaphragm and furnished with fixed and



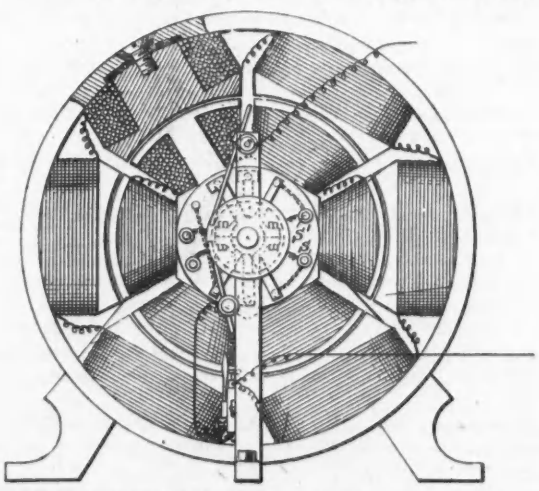
NO. 445,448.—REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

movable annular electrodes and in a receiver furnished with bobbins having cores formed of a number of separated pieces.

445,479. Electric Connection for Track Wiring; Sidney H. Short, of Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed Oct. 10, 1890. In combination with the track of an electric railway, the cross-connected main track wires, each connected with the adjacent line of rails through branch wires electrically connected with and mechanically fastened to said main track wires.

445,495. Leak Detector for Pipes; Andrew H. Brown, of New York. Application filed Sept. 20, 1890. In a leak-detector, the combination, with a casing adapted to be secured in the bottom of a drip pan, of a pivoted and counterbalanced forked lever, a bucket provided with trunnions by which it is hung upon the said lever, and contact plates connected with an annunciator, said plates being arranged one above the other and adapted to be pressed into contact with each other by the said lever.

445,499. Electric Motor; William M. Dresskell, of Brainerd, Minn. Application filed June 9, 1890. In an electric motor, the combination, with the armature-coils, of an insulating-disc carrying series of contact points connected with the armature-coils, and two three-armed switch-arms placed upon the armature



NO. 445,499.—ELECTRIC MOTOR.

shaft, insulated from each other and from the shaft, and adapted to change the connections of the armature from series to parallel or the reverse. (See illustration.)

445,515. Conductor Switch for Electric Railways; Frank J. Sprague and Johan F. S. Branth, of New York. Application filed Sept. 27, 1888. In an electric railway, the combination of a suspended conducting wire which receives an upward pressure from traveling grooved contact wheels, a branch wire and a switch plate at the junction for receiving the upward thrust of the contact wheels, said switch plate having a movable deflecting rib for guiding the contact wheels across its surface.

445,521. Commutator Brush-Holder for Electric Motors; George Herbert Condict, of Philadelphia, Assignor to the Electric Car Company of America, of same place. Application filed April 18, 1890. The combination of a commutator, two brush holders movable to or from the commutator, a screw-threaded tension rod for drawing said brush-holders toward each other, and an adjusting nut provided with a weight, whereby said nut may be maintained in any predetermined position upon the rod and be unaffected by the jarring of the machine.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y